JANUARY, 1955

METAL FINISHING

DEVOTED EXCLUSIVELY TO METALLIC SURFACE TREATMENTS

FOUNDED 1903

Enthonics AT WORK

Go from GRIME . . . to . . . SHINE . . . in SECONDS!

Use ENTHONE Emulsion Cleaner 75

DIP . . . . steel parts to be cleaned in Emulsion Cleaner 75 for only ***15 seconds.*** This simple immersion is done at room temperature (no heating facilities required) and with no irritation of the operator's nose, throat or skin.

RINSE . . in plain water.

DONE . . . and done *thoroughly* . . . in seconds! All heavy oil films and solid dirt have been removed from every corner and crevice . . . from slots, tapped holes and sculptured patterns.

INSURE . smooth, bright, adherent electrodeposits.

WRITE FOR FREE LITERATURE ON THIS SIMPLE, FAST, SAFE . . . AND ECONOMICAL . . . METHOD OF CLEANING METALS.

ENTHONE INCORPORATED

METAL FINISHING PROCESSES
442 ELM STREET, NEW HAVEN 11, CONNECTICUT
ELECTROPLATING CHEMICALS

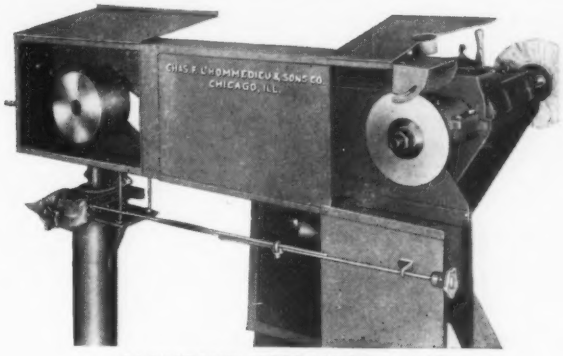
Service Representatives and Stock Points: BINGHAMTON, N. Y., Austin F. Fletcher, Inc.; CHICAGO, Ardco, Inc.; CLEVELAND, R. O. Hull & Co.; DALLAS, Weaver Engineering & Supply Co., Inc.; LOS ANGELES, L. H. Butcher Co.

Metal Finishing is published monthly by the Finishing Publications, Inc., 381 Broadway, Westwood, New Jersey, U.S.A.
Entered as second class matter at the Post Office in Westwood, N. J. Volume 53, No. 1, January, 1955. Four Dollars Per Year.

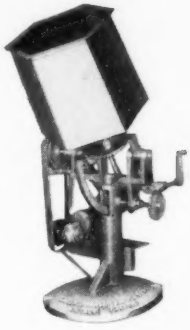
USE "RELIANCE" PRODUCTS FOR

ECONOMY : EFFICIENCY : DEPENDABILITY

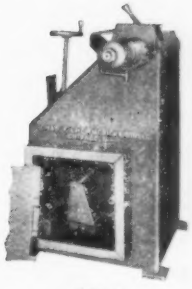
WRITE FOR FURTHER DETAILS



BACKSTAND IDLER WITH LATHE

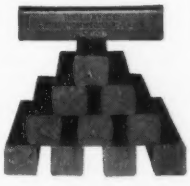


OBLIQUE
TUMBLING BARREL



#23A
POLISHING LATHE

BACKSTAND IDLER



EXTRUDED COMPOSITIONS
STANDARD SIZE
2 x 2 x 10"

NUWAY BUFFS FOR
FAST CUTTING

Chas. F. L'Hommedieu & Sons Co.

MANUFACTURERS of

Plating and Polishing Machinery

Complete Plating Plants Installed

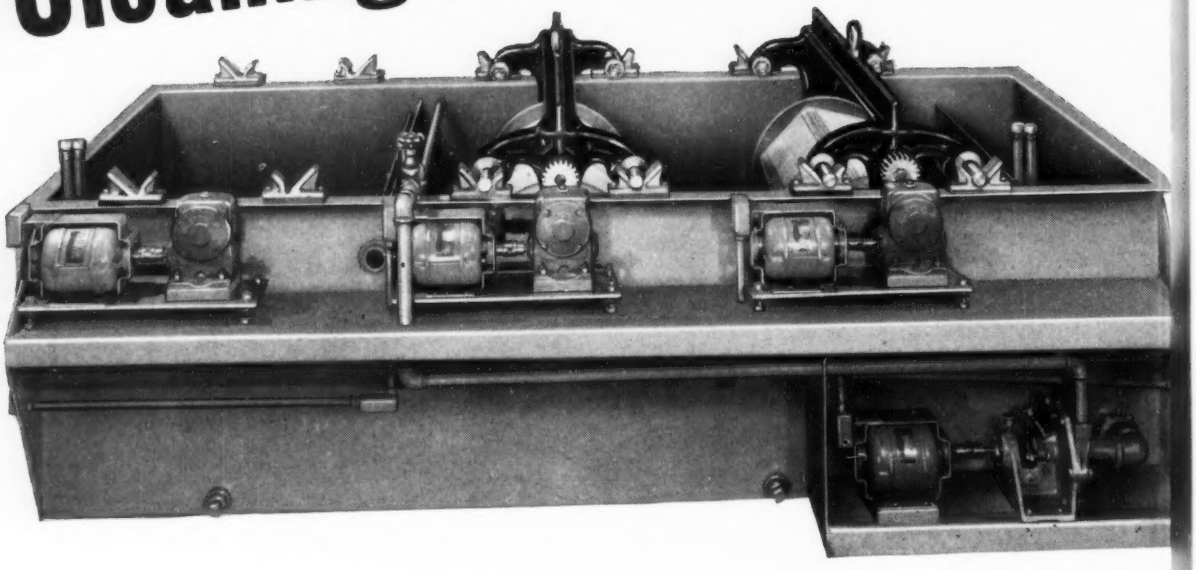
C. B. Little
Newark, N. J.
W. R. Shields
Detroit, Mich.
Powell Calvert
104 Second Street
Feasterville, Pa.

Gen. Office and Factory:
4521 Ogden Ave.
CHICAGO

Branches:
Cleveland
and
Los Angeles

STUTZ
Alkali Cleaning and Rinsing Units

for Heavy Duty High Speed Production!



Stutz design in single or multiple units with or without rinsing compartment. Solution circulating pump for rapid elimination of surface grease into trap from which complete removal made by simply draining of trap compartment daily.

Rotation of work in cylinders together with solution agitation of pump, provides complete cleaning in a single operation.

Cylinder drive and pump motors are 1/3 h.p. 440-220-3-60 with heater type motor control switches. Plate or pipe coils installed.

With this type of equipment, vapor degreasing is not required.

Can also be furnished for electrolytic cleaning and with P. R. current will do excellen removal of heavy furnace scale, rust, etc.

STUTZ *Portable Plating Barrels*

- The Stutz Portable Barrel is made in 2 standard sizes with cylind having inside dimensions of 6" x 12" and 8" x 18".
- Baskets in perforated metals or wire mesh.
- Load/Unload Stand for convenient and fast handling of work lo

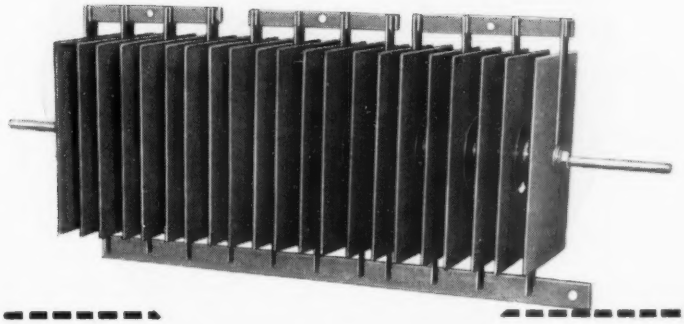
WRITE FOR PRICES AND ILLUSTRATED CATALOG

GEORGE A. STUTZ MFG. CO.

1645 Carroll Aven
Chicago 12, Illino

"Complete metal finishing equipment and supplies"

Six Square Inches per Ampere* of "Heart"!



The selenium stack is the heart of any selenium rectifier. For it is the quality of the stack and its accompanying circuitry that determines the effectiveness of a rectifier, just as the state of the heart and blood vessels of a human determine his strength and health.

IT'S A PROVEN FACT, RAPID RECTIFIER STACKS STAND UP LONGER IN HARD SERVICE. HERE'S WHY:

1) Rapid allows 6 square inches per ampere of plate surface in full wave bridge circuits. For years we have maintained this standard (somewhat higher than other makes), since we feel allowing this much area results in maximum life expectancy.
2) The plates in Rapid stacks use triple purified Selenium.
3) They are carefully tested and balanced for even current distribution.
4) They are coated with an exclusive material rendering them absolutely impervious to the corrosive conditions existing in plating rooms.
5) The plates are spaced an average of ½ inch, diminishing the possibility of dust, dirt and corrosive material becoming lodged between plates, thus allowing heat to dissipate readily.

Rapid designs its stacks to much higher standards than most other manufacturers.**

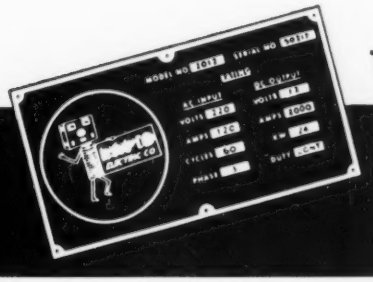
For example:

In tests performed at ambient temperatures of over 30°C, a recognized electrical manufacturers' group standard allows a temperature rise in the stack of 60°C; and, a rise of 40°C at the same ambient temperature for 1000 hours is permitted without derating.

Rapid standards permit a maximum stack temperature rise of only 22°C above the ambient. This low rise is made possible only because of the large area used per ampere, the plate spacing, high purity of Selenium used, the advanced circuitry and the engineering skill which designs the complete rectifier unit for the specific job.

So, when you buy a rectifier, check its heart. Make sure the one you buy offers the most advanced design for longest life . . . In other words, make sure you get a Rapid Rectifier.

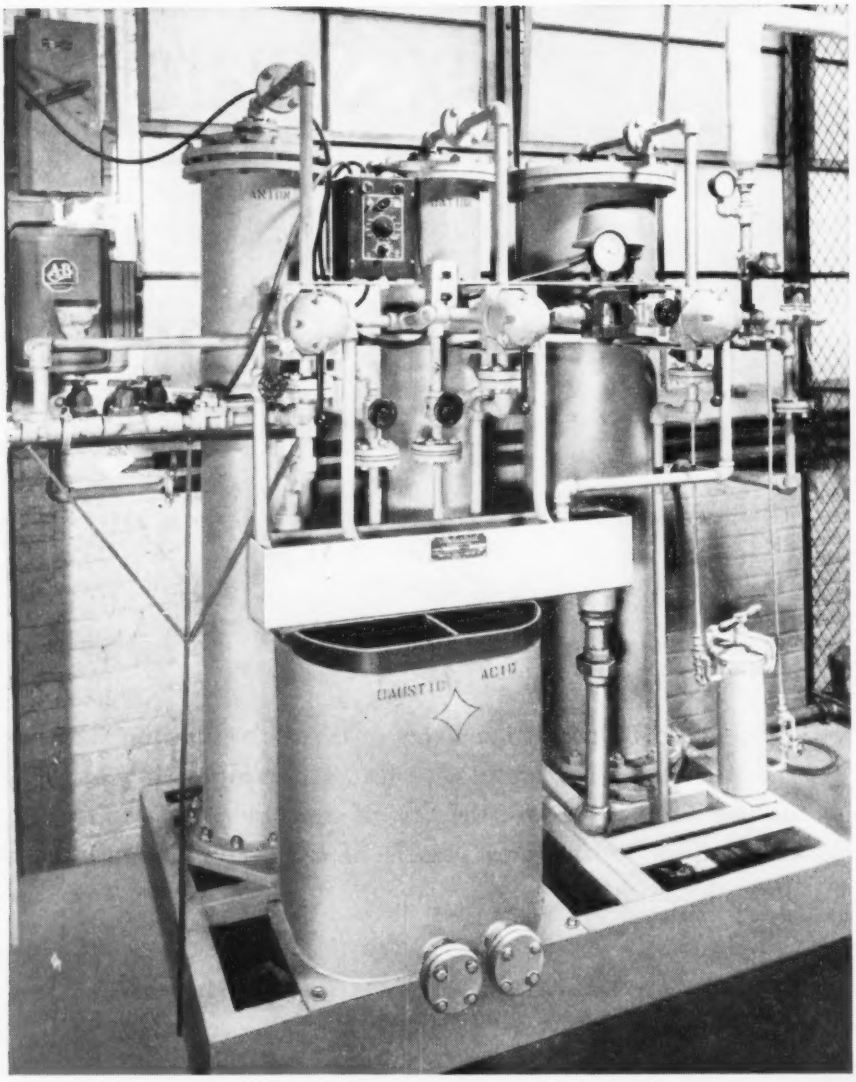
*In forced air cooled, three phase, full wave bridge circuit units.
**All three phase rectifiers are designed with a full wave circuit.



THE NAMEPLATE THAT MEANS *"More Power to You!"*

RAPID ELECTRIC COMPANY

2881 Middletown Road • New York 61, N. Y. • Phone: Talmadge 8-2200



treating plating rinse wastes at

Sunbeam CORPORATION

CHICAGO 50, ILLINOIS

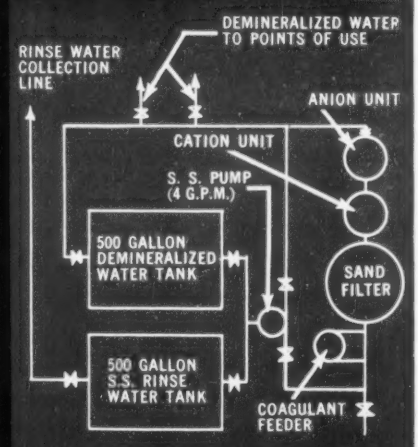
INDUSTRIAL waste treating unit consisting of rubber-lined sand filter with coagulant feeder, cation and anion exchangers complete with pumps, used for treating plating rinse water to remove gold and nickel salts, remove sulfuric and boric acids and return demineralized water to the recirculating system.

Industrial tailored treating units pay for themselves

INDUSTRIAL units for the treatment of metal finishing wastes are used for the recovery of precious metals and for supplying demineralized water for stainless rinsing. The value of the recovered metals, reuse of demineralized water in the recirculating system, and the elimination of troublesome contaminants all add up to pay for the installation, frequently within a matter of months.

Complete INDUSTRIAL Systems are individually engineered and built to meet specific waste treatment problems. Write for full particulars and recommendations.

5453

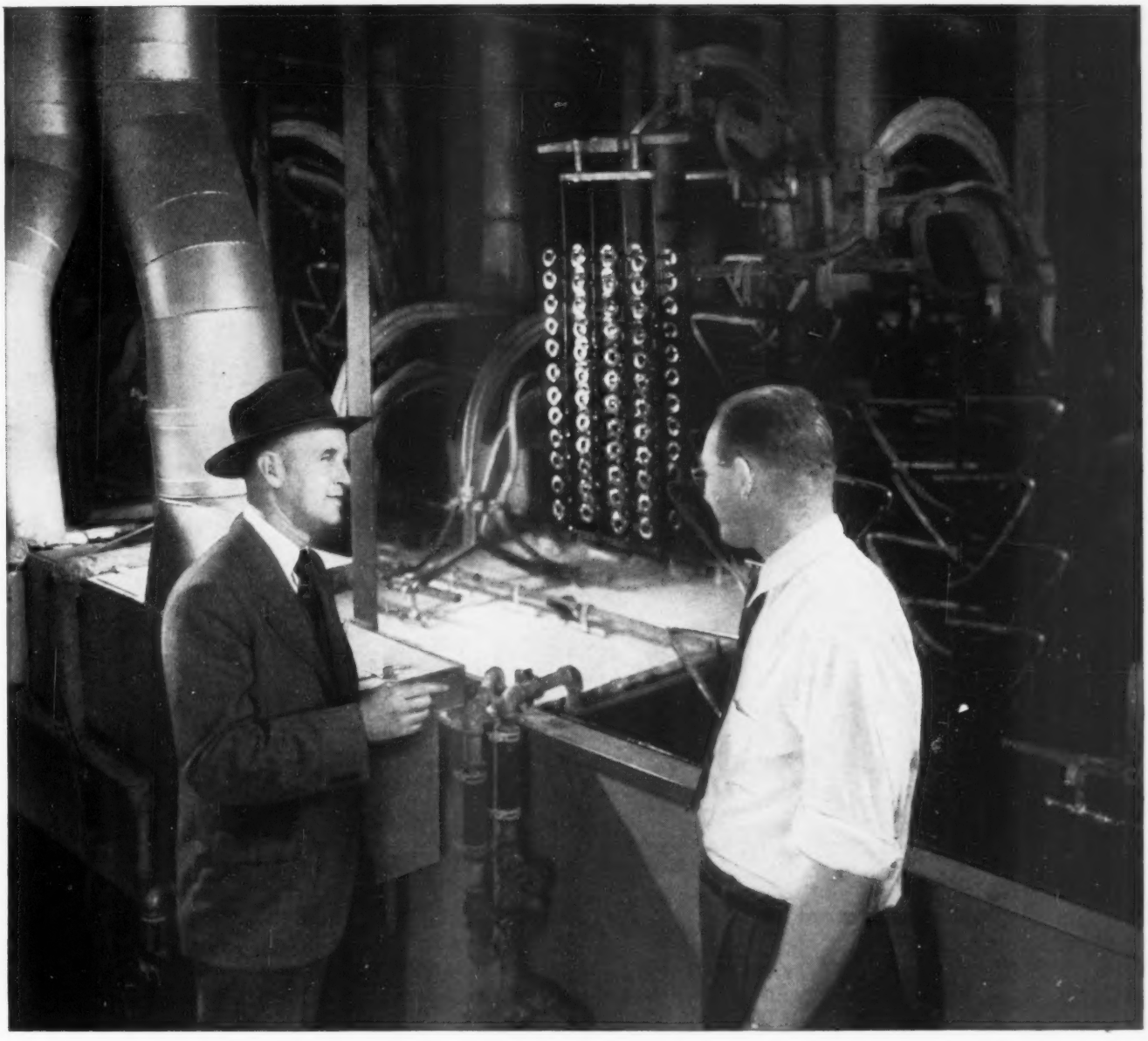


Flow diagram of the INDUSTRIAL System for the demineralization of recirculated rinse water.

INDUSTRIAL FILTER & PUMP MFG. CO.

5906 OGDEN AVENUE • CHICAGO 50, ILLINOIS

PRESSURE FILTERS
ION EXCHANGERS
RUBBER LININGS
HEAT EXCHANGERS
CENTRIFUGAL PUMPS



A NEW APPROACH TO PICKLING AND DESCALING PROBLEMS

Pennsalt PM-90 and Pennsalt Technical Service

Those headaches of raw acid pickling can be eliminated! Now Pennsalt PM-90 will remove oxides and scale with speed and efficiency. Here's what you can have:

- *Brighter finish*
- *Smoother finishes (less plate wasted)*
- *Simplified maintenance*
- *Reduced cost*

Pennsalt PM-90® is a specialty acid-type cleaner that does everything a raw mineral acid bath will do — yet *avoids harmful attack on the base metal.* This gives you two direct advantages:

1. You reduce the demands on your foreman's time. The pickling operation no longer requires constant supervision to prevent burning and pitting.
2. You cut operating costs. Tank life increases sharply since the acid strength is not wasted in excess action.

Before you change to PM-90, test the rest of your operation, too. Call your Pennsalt Metal Cleaning Specialist for a free survey of your cleaning line. That way, you can be sure of getting top efficiency from every tank in the line.

Or write: Pennsylvania Salt Mfg. Co., Metal Processing Dept., EAST: 982 Widener Bldg., Philadelphia 7, Pa. WEST: Woolsey Bldg., 2168 Shattuck Ave., Berkeley 4, Calif.

Pennsalt Chemicals

Q

- HOW TO INCREASE **P-B***
- OPERATIONS and REDUCE COSTS!

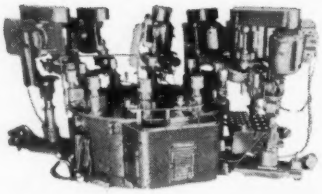
A

- WITH **PACKER-MATICS**
- OF COURSE!

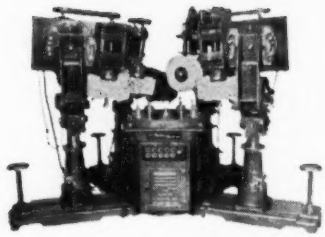
Because Packer-Matics polish, buff and deburr automatically, production soars — buffing costs are materially reduced. Interchangeable heads permit the use of tampico, sisal, wire wheels and cotton buffs. Vital parts are lubricated and protected in dust proof oil reservoir to reduce wear and maintenance costs. All electric push button controls, centrally located, assure ease of operation.

Remember, regardless of your buffing problems . . . Packer-Matic makes the equipment to solve it. Our engineering department will be glad to show you how Packer-Matic rotary, indexing, and straight-line equipment can increase your profits . . . reduce your overhead. ***Write us today.***

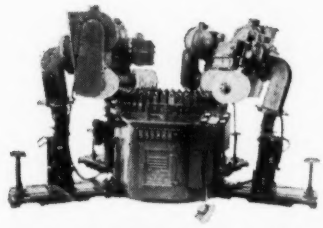
**Polishing & Buffing*



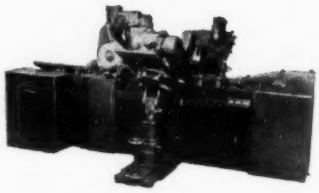
No. 13-10 ROTARY INDEXING



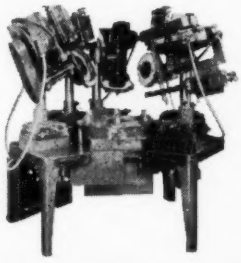
No. 4-5 ROTARY INDEXING
Handles units from ¼" to 12½" in diameter. Production varies from 350 to 1050 pieces per hour.



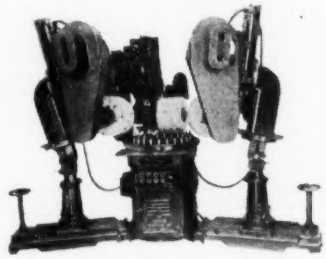
No. 14-45 CONTINUOUS ROTARY
Handles units from 1" to 12" in diameter. Standard range from 1070 to 4290 pieces per hour.



No. 1 STRAIGHT LINE CONVEYOR
Available in lengths according to work and number of heads. Conveyor speeds vary per job.



No. 9-4 ROTARY INDEXING
Heads are mounted on table as part of machine. Production range from 500 to 1500 pieces per hour.



No. 4-24 CONTINUOUS ROTARY
Handles units from ¼" to 3" in diameter. Production range from 1,000 to 3,000 pieces per hour.

PACKER-MATIC

AUTOMATIC MACHINES FOR BUFFING • POLISHING • DEBURRING

THE PACKER MACHINE COMPANY • MERIDEN, CONN.

DOES POOR CLEANING SPOIL YOUR *Decorative Plating*

Don't let hazing, spotting in low-current areas, appearance of waterbreaks, or "half-way" cleaning ruin your plating work. Your Cowles Technical Man will remedy these and similar decorative plating headaches with Cowles FE, a highly alkaline electrolytic cleaner.

Designed for both direct and reverse electro-cleaning, Cowles FE is recommended for ferrous metals where extra-heavy dirt loads must be removed and high alkalinity and high current-carrying capacity are necessary.

Cowles FE Cleaner eliminates poor rinsing, "half-way" cleaning, short cleaner life. Solutions will not break down under electrolysis.

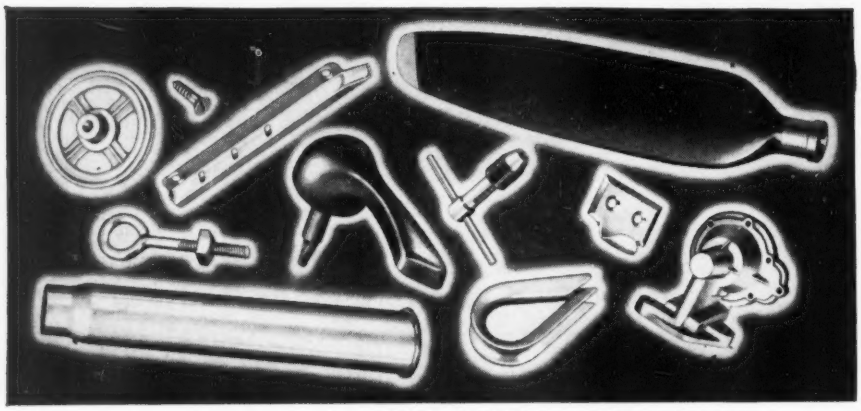
Let your Cowles Technical Man demonstrate Cowles FE Cleaner in your shop. Write or call today to arrange a convenient appointment.

COWLES CHEMICAL COMPANY
Metal Cleaning Department
7016 Euclid Avenue **Cleveland 3, Ohio**

CHEMICAL PROGRESS WEEK-MAY 17-22

Extra opportunities to cut costs with zinc finishing

Wider choice of corrosion resisting chromate finishes being offered



Some of the many products finished in Unichrome Dips or Anozinc

CHROMATE treating still remains one of the best ways to finish zinc die castings or zinc plated steel. It strengthens corrosion resistance. It's an *easy* way to finish. It's economical. And time has proved its quality.

With such a combination of virtues offered in a finish, it pays designers, metal finishers and production men to review their products—and to evaluate the benefits of chromate finishing against their finishing requirements. Especially today—when the pressure is on to cut costs every possible way.

Through the unusually wide choice of finishes United Chromium provides, even greater benefits become possible. Here's why. A more economical dip solution may be chosen. Or a production advantage may be realized.

FOR EXAMPLE:

The right Unichrome Dip meant half the material consumption and longer solution life to one company.

Brighter finish on zinc plated hardware with less solution-waste was gained in another plant with still another compound.

Chromate treating of zinc plated steel shell cases done electrolytically with Anozinc is found best and cheapest in the long run by many producers.

HERE IS VARIETY

Unichrome chromate finishes offer a good color choice. Lustrous, clear bright finish or black—brassy yellow or olive drab—even brass-color—all these can be produced chemically by Unichrome Dip solutions.

Unichrome chromate finishes also satisfy production method requirements. Compounds are available for manual or automatic operation.

An exclusive electrolytic process, Anozinc* rounds out this complete line of conversion coatings. It's found especially economical in continuous, large run automatic production. This process permits finished parts to be handled while wet.

Write for more data. *Trade Mark

NEW SAVINGS IN COPPER PLATING

New addition agents for use with Unichrome Pyrophosphate Copper have eliminated buffing for many users, made it easier for others who prefer to buff copper rather than the base metal or subsequent deposits. Plating speed has been increased—by as much as 20% in some cases. Need for expensive waste treatment prior to disposal are also being reduced because the bath contains no cyanide.

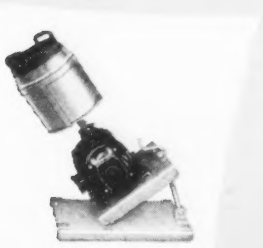
Lasting paint jobs can be applied overnight

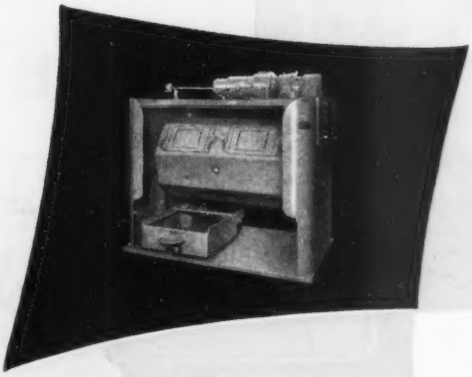
Many plating plants are doing painting that gives 3 or more years protection against plating acids, cleaning solutions, and moisture. This cost-cutting durability is being achieved with Ucilon* Protective Coating Systems which are designed not only to withstand severest service conditions but also to apply fast. Coatings dry to touch in about 10 minutes. A complete job with the required number of coats for the service can easily be done overnight, thereby avoiding any downtime. *Trade Mark

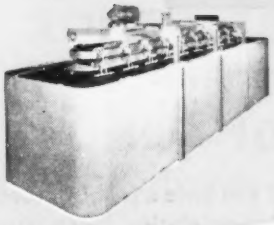
HELPFUL HINTS

by "Mr. Cost Cutter"

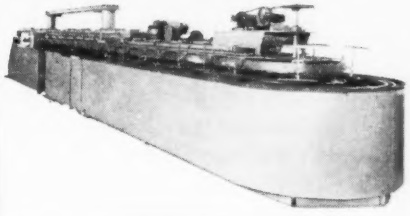
One of the finest coatings possible for degreaser dipping baskets is provided by vinyl plastisol compounds because their heavy, resilient build-up prevents scratching of parts. Platers now using Unichrome Coating 218X for racks have one of the finest plastisol formulations available for these baskets, too. This coating withstands all plating solutions and provides unusually long service in vapor degreasing cycles!



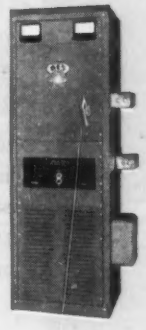


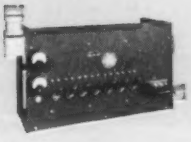


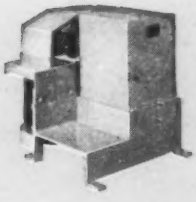
CROWN equipment

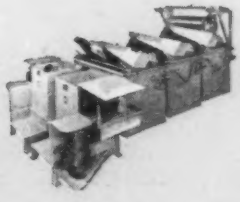


- Automatic Machines for Plating-Anodizing, etc.
- Dryers, Centrifugal
- Partially Automatic Plating Machines
- Plating Barrels
- Rectifiers
- Rheostats, Switches — Controls
- Tray — Transfer Type Cleaning — Rinsing — Dipping Units
- Tumbling Barrels — "Horizontal" — "Tilting"
- Special equipment designed and built





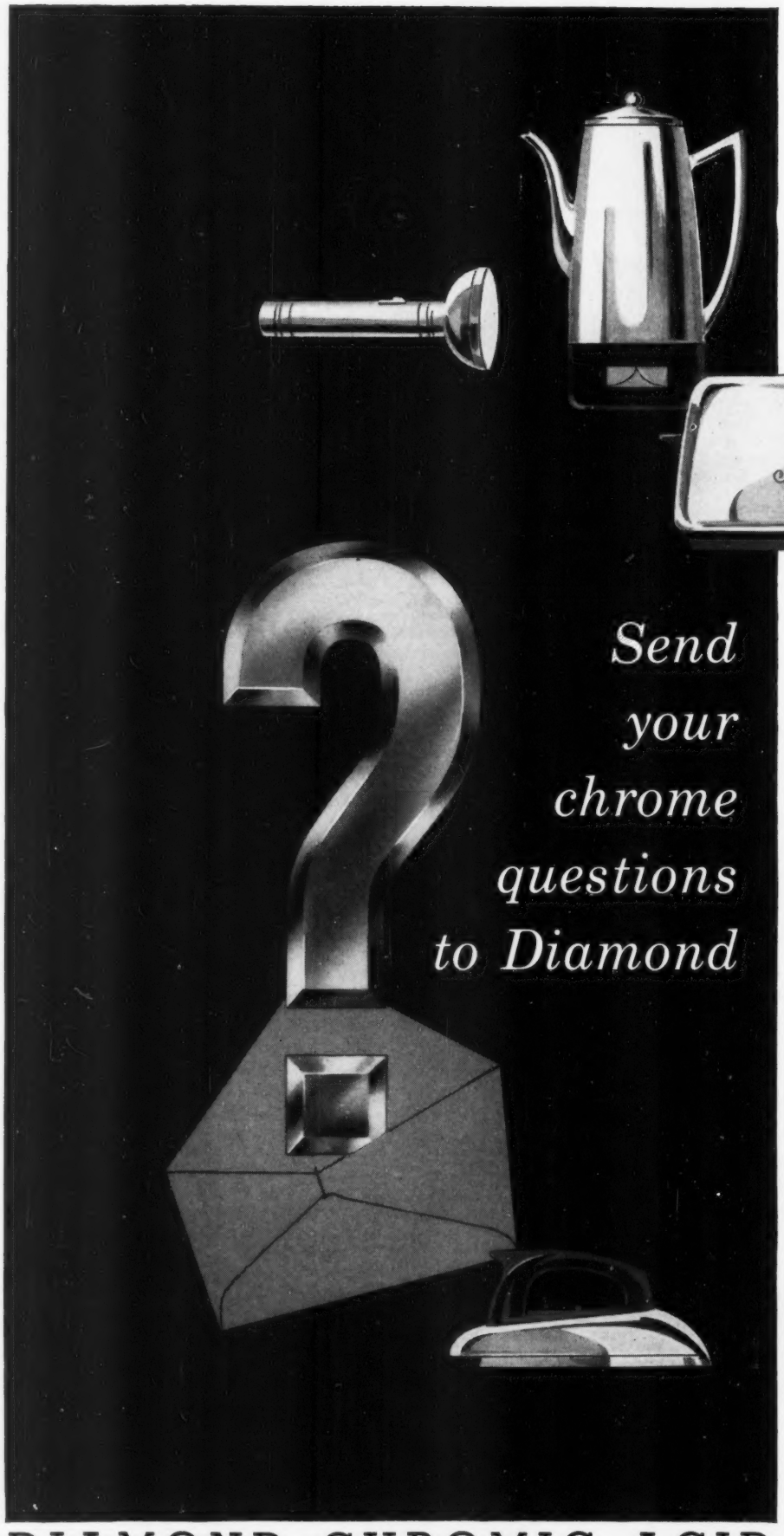




COMPLETE DETAILS SENT PROMPTLY ON REQUEST

CROWN RHEOSTAT AND SUPPLY COMPANY

3465 N. KIMBALL AVENUE • CHICAGO 18, ILLINOIS



If you have a problem connected with chrome plating, bring it to DIAMOND. Our Chromium Chemicals Division is set up to handle your questions . . . completely and quickly. Our technical specialists can draw on a broad technical background plus extensive research and test facilities . . . all you have to do is ask.

The answers you'll receive carry the weight of broad experience for no manufacturer controls more steps in the making of Chromic Acid. DIAMOND experience and know-how go right back to making the soda ash and importing the chrome ore and includes every step through production and delivery, right up to standing by your side, if you wish, to help you get uniform, high-quality plating results.

Nine warehousing points and sales offices across the country assure you fast service, uninterrupted supply. DIAMOND ALKALI CO., 300 Union Commerce Bldg., Cleveland 14, Ohio.

DIAMOND CHROMIC ACID

DIAMOND ALKALI CHEMICALS ®

Like MAGIC...

ROHCO®

ZINC BRIGHTENERS

add Diamond-Bright Sparkle to Your Zinc Plating!

ROHCO 303
(for still or automatic)

ROHCO 100
(for barrel)

For Brilliant Zinc Deposits

Rohco 100 Barrel Brightener imparts brilliance to zinc plating that is almost unbelievable until observed. It exhibits high covering power so that recesses, usually unplated, are easily covered with a substantial thickness of deposit. ROHCO 303 Still Brightener gives unusually bright deposits that offer ideal surfaces for bright dipping to even greater lustre or for conversion coatings by chromic acid treatment. Minimizes consumption for bright dips. Exhibits high covering power so that recesses are easily plated. The cost of ROHCO 100 and ROHCO 303 is far less than would be anticipated for the many advantages realized in uniformly highest quality, maximum production, and minimum costs.

PERMA-BRITE "S"
(for still or automatic)

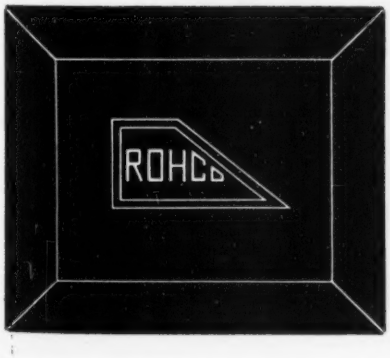
PERMA-BRITE "B"
(for barrel)

For Economical Bright Zinc Deposits

The most important cyanide zinc plating development in 15 years, Perma-Brite Zinc Brighteners are most economical in giving wonderful, bright zinc deposits, preferably after bright dipping; high throwing power and covering power; perfect for conversion coatings. Perma-Brite Zinc Brighteners have an extremely wide effective concentration range; added directly to the plating bath once a week or once a day as desired, just as it comes in liquid form; stable in idle baths; Perma-Brite makes zinc anodes corrode smoothly. After initial addition of Perma-Brite, production figures show a consumption rate as little as ⅛ oz./gal. per 40 hour week for still plating. For barrel plating the rate is comparable, based upon ampere hours.

R. O. HULL & COMPANY, INC. 1301 Parsons Ct., Rocky River 16, Ohio

DISTRIBUTORS: CHICAGO, Ardco, Inc. • TORONTO, CANADA, Armalite Company, Ltd. • LOS ANGELES-SAN FRANCISCO, Crown Chemical & Engineering Co. • NEWARK, Daniels Plating Barrel & Supply Co. • ST. LOUIS, Davies Supply & Manufacturing Co. • NEW ENGLAND, NEW YORK, PENNSYLVANIA, Enthone, Inc. • MINNEAPOLIS, W. D. Forbes Co. • DETROIT, George L. Nankervis Co. • FT. WORTH, DALLAS, Weaver Engineering & Supply Co.



R. O. HULL & COMPANY, INC.
1301 Parsons Court
Rocky River 16, Ohio

Yes: Send FREE Information on:
☐ 100 AND 303 ZINC BRIGHTENERS
☐ PERMA-BRITE "S" AND PERMA-BRITE "B"

Name ..... Title .....
Company .....
Street Address .....
City ..... Zone ..... State .....

NOW THE NUMBER OF

RICHARDSON-ALLEN

SELENIUM RECTIFIERS *in use by this company*

HAS REACHED

100

Performance Did It!

So great was the satisfaction given by the initial installation of 22 R-A Selenium Rectifiers in The Perfect Circle Corporation's plants in Hagerstown and Richmond, Indiana, and in Toronto, Canada, that today the number in their plants totals 100!

These units, rated mostly at 12 volts, 1500 amperes, are of special design needed for that fine uniformity of chromium plate which is a "must" in all Perfect Circle Fiston Rings.

The rapid spread of R-A installations throughout industry is due to just this kind of performance!

Courtesy of The Perfect Circle Corporation

ADVANTAGES OF RICHARDSON-ALLEN SELENIUM RECTIFIERS IN THE PLATING INDUSTRY

- Marked increase in production
- Notably improved plating quality
- Full power at once; no warm-up
- Reduction in number of rejects
- No moving parts except cooling fans
- Practically no maintenance expense
- Capacities from 250 to 12,000 amperes in single packages
- Special switches or controls for chrome, bright nickel, gold, silver, anodizing
- The ideal rectifier supply for anodizing
- "Heat Exchanger" available for operation in corrosive atmospheres

RICHARDSON-ALLEN CORPORATION

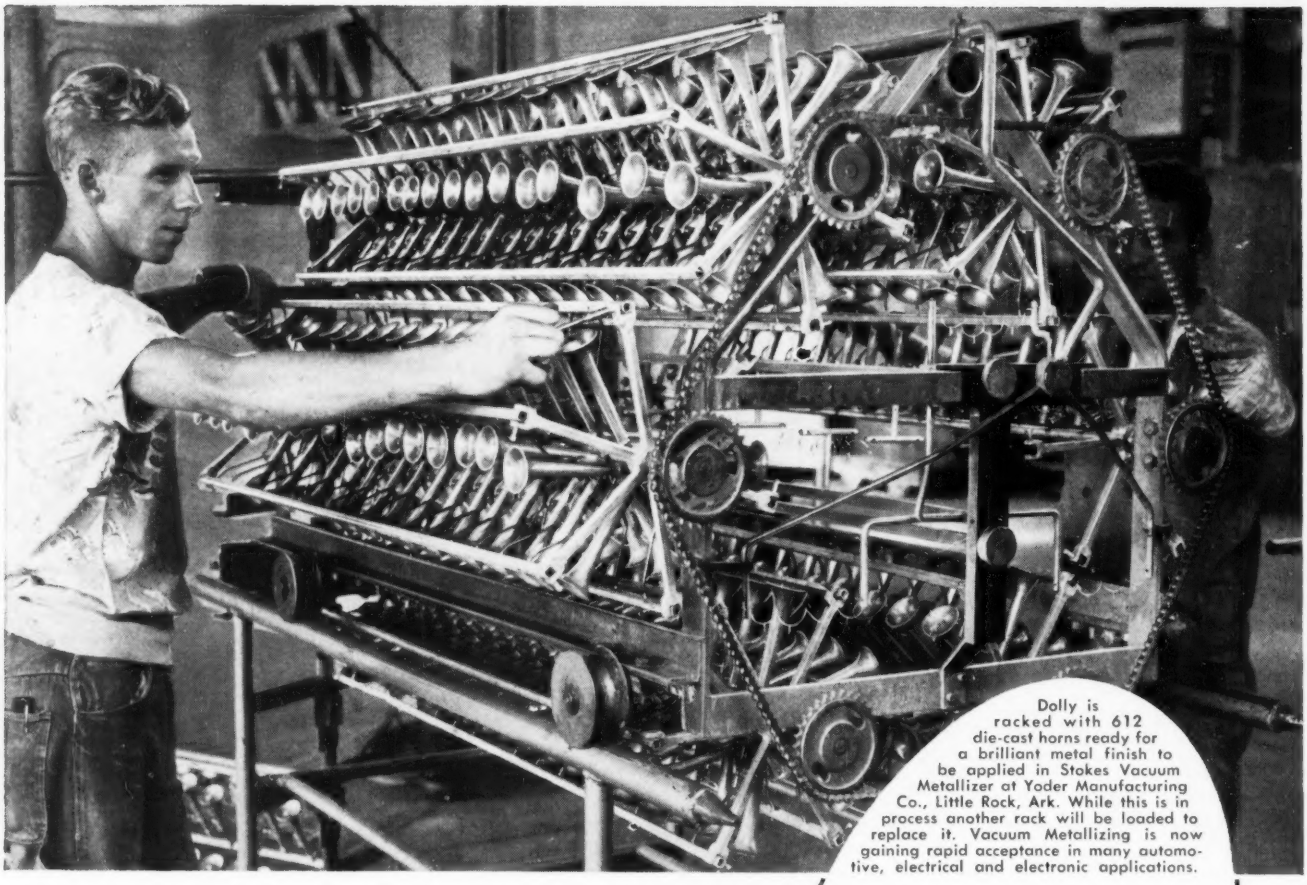
a manufacturing affiliate of

WESLEY BLOCK AND COMPANY

39-15 MAIN STREET, FLUSHING, NEW YORK

IN CANADA: Richardson-Allen of Canada, Ltd., 370 Victoria St., Toronto, Ontario

DEPENDABLE POWER FOR EVERY DC NEED



Dolly is racked with 612 die-cast horns ready for a brilliant metal finish to be applied in Stokes Vacuum Metallizer at Yoder Manufacturing Co., Little Rock, Ark. While this is in process another rack will be loaded to replace it. Vacuum Metallizing is now gaining rapid acceptance in many automotive, electrical and electronic applications.

In Minutes...Vacuum Metallizing will Metal-coat these 612 Die-cast Horns

Metallic finishes in many metals and many colors are now applied by Vacuum Metallizing and the product is ready for lacquering and packaging without hand work. No plating or finishing plant can afford to ignore the tremendous opportunities which Vacuum Metallizing creates.

Ornaments and display materials, toys, trophies, furniture handles, emblems, jewelry, nameplates, reflectors and many other metal parts are now largely vacuum metallized. Automobile parts are a new and fast-growing market. Electrical and electronic parts offer unlimited possibilities. Some installations deliver as high as 100 loads of finished parts per 24-hour day from a single Stokes Vacuum Metallizing unit without use of specially skilled labor. Stokes trains your workmen and you start into production.

Units of 24, 36, 48 and 72-inch diameter are available, some fully automatic in operation. Floor space requirements are low, as these are integrated "package" units of the fastest and most efficient type.

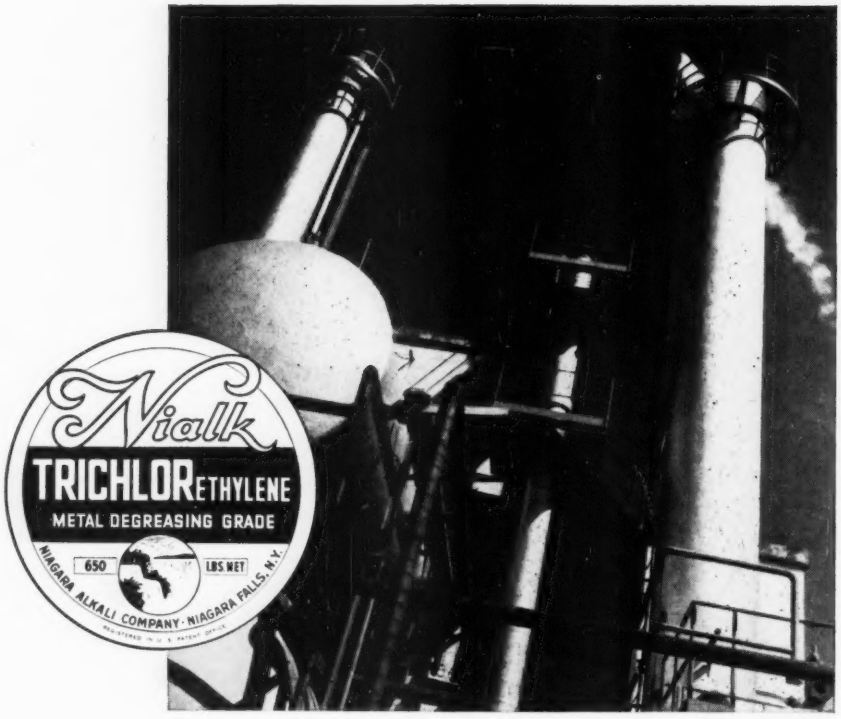
Stokes Laboratory will metallize your samples, evaluate your application, recommend techniques to be employed, plan cycles, report on costs . . . and share with you the benefits of Stokes' 40 years of leadership in high-vacuum technology.

Write today for a comprehensive brochure, "Vacuum Metallizing Today," which describes the applications and techniques of Vacuum Metallizing.

F. J. Stokes Machine Company
Philadelphia 20, Pa.

STOKES

STOKES MAKES: High Vacuum Equipment, Vacuum Pumps and Gages / Industrial Tabletting, Powder Metal and Plastics Molding Presses / Pharmaceutical Equipment



GET FAST DEGREASING AND SAVE MONEY with NIALK® TRICHLORETHYLENE

(Nonflammable, stable, completely reusable)

In terms of low cost and quick action, you'll find Nialk TRICHLORethylene beats anything yet for leaving metal parts clean, warm and dry, ready for surface treatment.

Take Nialk TRICHLORethylene's low boiling range for example. It is 86.6°C—87.8°C, based on standard ASTM tests. That means quick vaporization. Together with its low specific heat (less than ¼ that of water), you'll have a solvent that really cuts fuel costs.

You'll save money on Nialk TRICHLORethylene's high vapor density too, (4.5 times that of air) because a proper level will be maintained at all times in the degreasing machine. Result: more efficient cleaning with low solvent loss.

Nialk TRICHLORethylene is nonflammable at room temperature. There is no worry about fire when you take the ordinary precautions required in the handling of any chlorinated hydrocarbon.

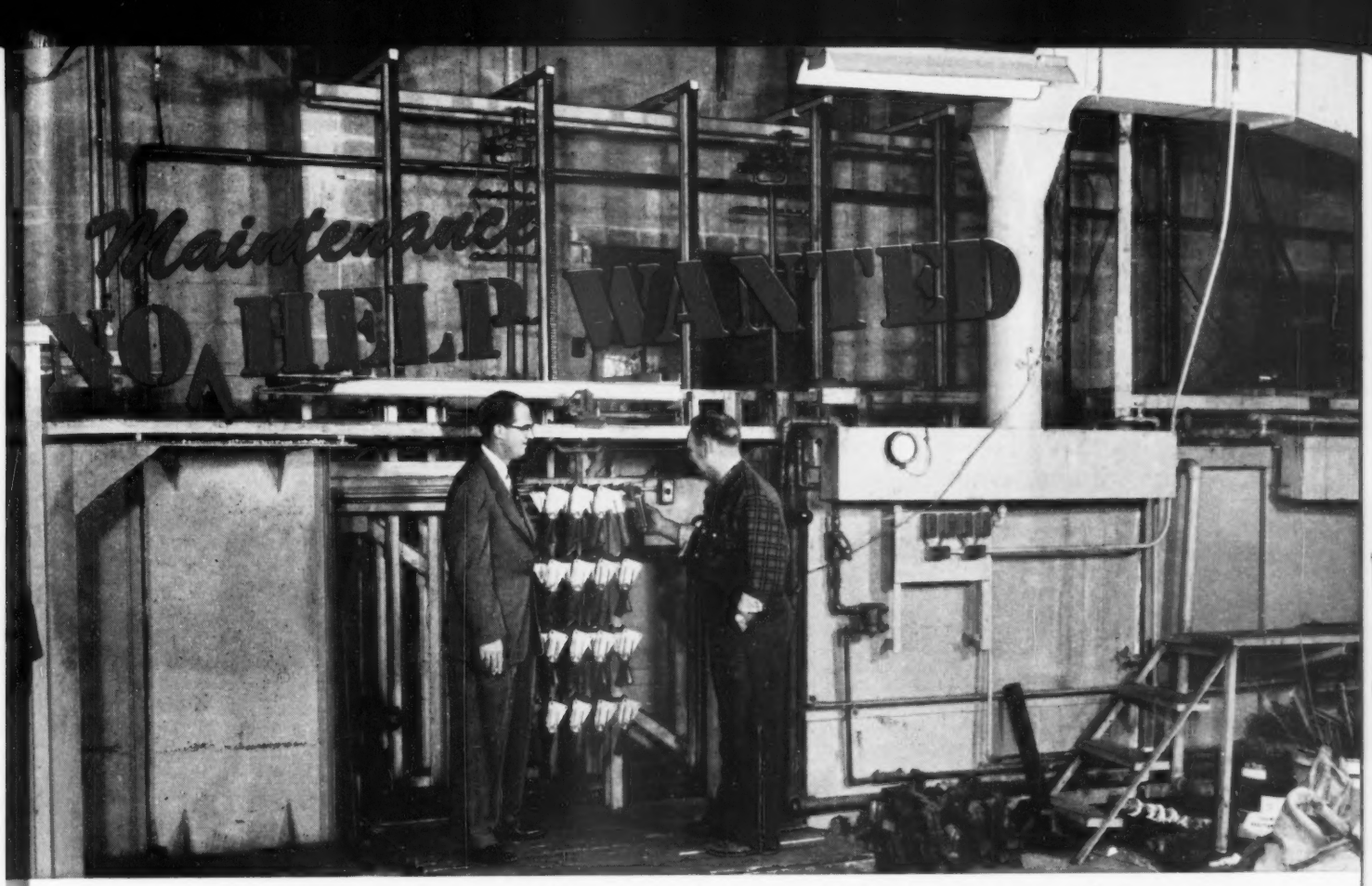
Nialk TRICHLORethylene is stable and completely reusable. And whether you use a carload or a drum, there's no extra premium for TRICHLORethylene's top quality.

Try Nialk TRICHLORethylene for your degreasing operation. On tough jobs like waxes, oils, tars, gums and even metal chips, you'll find it does the job quickly, thoroughly, safely and economically. We'll be happy to send you further information in terms of your own application.

NIAGARA ALKALI COMPANY

60 East 42nd Street, New York 17, New York

NIALK Liquid Chlorine • NIALK Caustic Potash • NIALK Carbonate of Potash • NIALK Paradichlorobenzene • NIALK Caustic Soda
NIALK TRICHLORethylene • NIAGATHAL® (Tetrachloro Phthalic Anhydride)



"...a year of continuous daily operation, without an hour of downtime due to breakdown or maintenance requirements," **WRITES THE PRESIDENT OF WALLACE J. IVERS CO.**

WALLACE J. IVERS CO.
Metal Finishers
6830 MARK TWAIN DETROIT 28, MICH.

October 28, 1954

Wagner Brothers, Inc.
400 Midland Ave.
Detroit 3, Michigan

Attention: Mr. Fred Wagner
Sales Manager

Gentlemen:

The first Wagner Brothers' Automatic Plating Machine ever built was installed in our plant one year ago to replace another type of machine. We were the first plater to have any production experience with this entirely new type of equipment. I thought that you might like to know that the performance of your Automatic has been excellent.

Our records show that your Automatic has delivered high-volume production, during a year of continuous daily operation, without an hour of downtime due to breakdown or maintenance requirements. It has been completely trouble-free.

In addition to this very superior maintenance record, the efficiency and productivity of this machine have enabled us to realize considerable savings in production costs.

If you ever want my recommendation to any of your customers, I'll be happy to tell them how I feel about this unit; the installation of your Automatic was one of the wisest moves we've ever made in our business.

Very sincerely,

WALLACE J. IVERS CO.

Wallace J. Ivers

Wallace J. Ivers,
President

WJI/jb

The Wagner Brothers' Full Automatic shown above is the first one built. It has now been in continuous operation for over a year at this Detroit job shop. Wallace J. Ivers states that, since its installation, this Automatic has never once halted high-volume production for maintenance or repairs. Wagner Brothers' Automatics are noted for minimized maintenance. Trouble-free performance is made possible by simplified design, fewer moving parts to wear, no vibrating parts, no backlash in automation, nor little chance of misalignment.

WITH WAGNER BROTHERS' AUTOMATICS YOU ALSO SAVE BECAUSE OF . . .

SMOOTH OPERATION—Hydromotor power eases racks through the plating cycle so smoothly that you waste no time fishing parts from tanks, dropped there by the jolting transfer action of ordinary automatics.

LOW POWER NEEDS—Requires less than ½ the power used by comparably-sized units because of balanced work load inherent in its advanced design.

SIMPLE INSTALLATION—No costly installation expense. Automatics are delivered either intact or in two or three basic sections, depending upon size. Simply position and level, make power and drain connections.

OTHER FEATURES—Operates under reduced overhead space—No greased parts or hydraulic fittings over tanks—Triple contacts on cathode bars—Automatic heat control—Start, stop, load and unload from one position—Drag and dwell times easily varied—and many other features.

write NOW for FREE, ILLUSTRATED BULLETIN B 50-54

YOUR *PRIMARY* SOURCE FOR PLATING AND POLISHING EQUIPMENT AND SUPPLIES

Wagner

BROTHERS, INC.

418 MIDLAND AVE. • DETROIT 3, MICHIGAN

REPRESENTED COAST-TO-COAST

BLACK MAGIC

meets every BLACK OXIDE FINISHING *Specification!*

BLACK MAGIC -- whether applied to civilian or defense production — has proved to be a versatile, economical finish. Its ability to blacken heat treated parts or previously "hard to blacken" items has established **BLACK MAGIC** as a finish capable of exceeding black oxide requirements.

Other advantages are:

- ★ One Bath - One Salt
- ★ Lower Operating Temperature
- ★ Self Rectifying
- ★ Faster Blackening Cycle
- ★ More Corrosion Resistant

MEETS GOVERNMENT SPECIFICATIONS

A comprehensive study of the application of a black oxide finish has been compiled and is now available in our latest catalog. The study also covers Black Magic Blackening Processes for other ferrous and non-ferrous metals; metal cleaners, rustproofing oils and waxes, plating specialties and a complete line of heat treating salts.

Write for your complimentary copy today.

Mitchell-Bradford

THE MITCHELL-BRADFORD CHEMICAL CO.

2442 Main St. Stratford, Conn.

QUALITY PRODUCTS OF CHEMICAL RESEARCH

FORD OF CANADA
BARREL PLATES AUTOMATICALLY IN

STEVENS AUTOMATIC BARREL Plating and Processing Machine

Tons of nuts, bolts, stampings, washers, screws and other small parts are automatically zinc plated in the modern Ford Motor Company of Canada, Ltd., plant every day. The machine that does the job is a Stevens Automatic Barrel Plating and Processing Machine.

In exactly 54 minutes a barrel makes the complete cycle of cleaning, acid dip, rinse and plating tanks, *automatically* empties the zinc plated parts and is ready to start the cycle again. Fifty-four similar barrels are continuously going through the same cycle.

There are hundreds of Stevens Automatic Barrel machines used by industry today. It is *proven* equipment. Management finds many cost saving advantages such as:

A uniform product • Less rejects • Minimum labor requirements • All operations controlled • An integral part of straight-line production • Low maintenance cost • Can easily meet future manufacturing changes • Processing flexibility • Lower cost of production per hour than any other method of processing • Lends itself to today's trend toward automation.

Are you plating your parts at the lowest possible cost? Check to see how Stevens Automatic Barrel Equipment can help you. Call your Stevens Sales Engineer or write direct.

Bookings for the showing in your plant of a twenty-six minute, 16 mm. sound film featuring the famed Stevens Automatic Barrel, will gladly be arranged.

BRANCHES: **BUFFALO • CLEVELAND • INDIANAPOLIS NEW HAVEN • DAYTON**

IN CANADA: **FREDERIC B. STEVENS OF CANADA, LTD. TORONTO • WINDSOR**

FOUNDRY FACINGS | GRINDING OPERATIONS | BLAST FINISHING | BARREL TUMBLING | METAL CLEANING | POLISHING & BUFFING | AUTOMATIC FINISHING | AUTOMATIC PLATING | METAL RECLAMATION

Metal Finishing equipment and supplies from castings or stampings to finished product.

FREDERIC B.
STEVENS
INCORPORATED
YOUR METAL FINISHING SUPERMARKET
DETROIT 16, MICHIGAN

MURRAY WAY

MICRO-POLISH strip grinding boosts output over 600 percent for Michigan manufacturer

The New Murray-Way rotary filter which efficiently reclaims coolant on this operation. Permanent filtering media saves the cost of this equipment in a short time.

- ★ **Assures Product Uniformity**
- ★ **Cuts Material Loss and Scrap**
- ★ **Eliminates Down-time**
- ★ **Replaces Two Expensive Hand Operations**
- ★ **Facilitates Subsequent Operations**
- ★ **Improves Product Appearance**
- ★ **Eliminates Dust and Mess**
- ★ **Pays For Itself**

Here's one more illustration of Murray-Way's ability to do the job better, faster, and more economically.

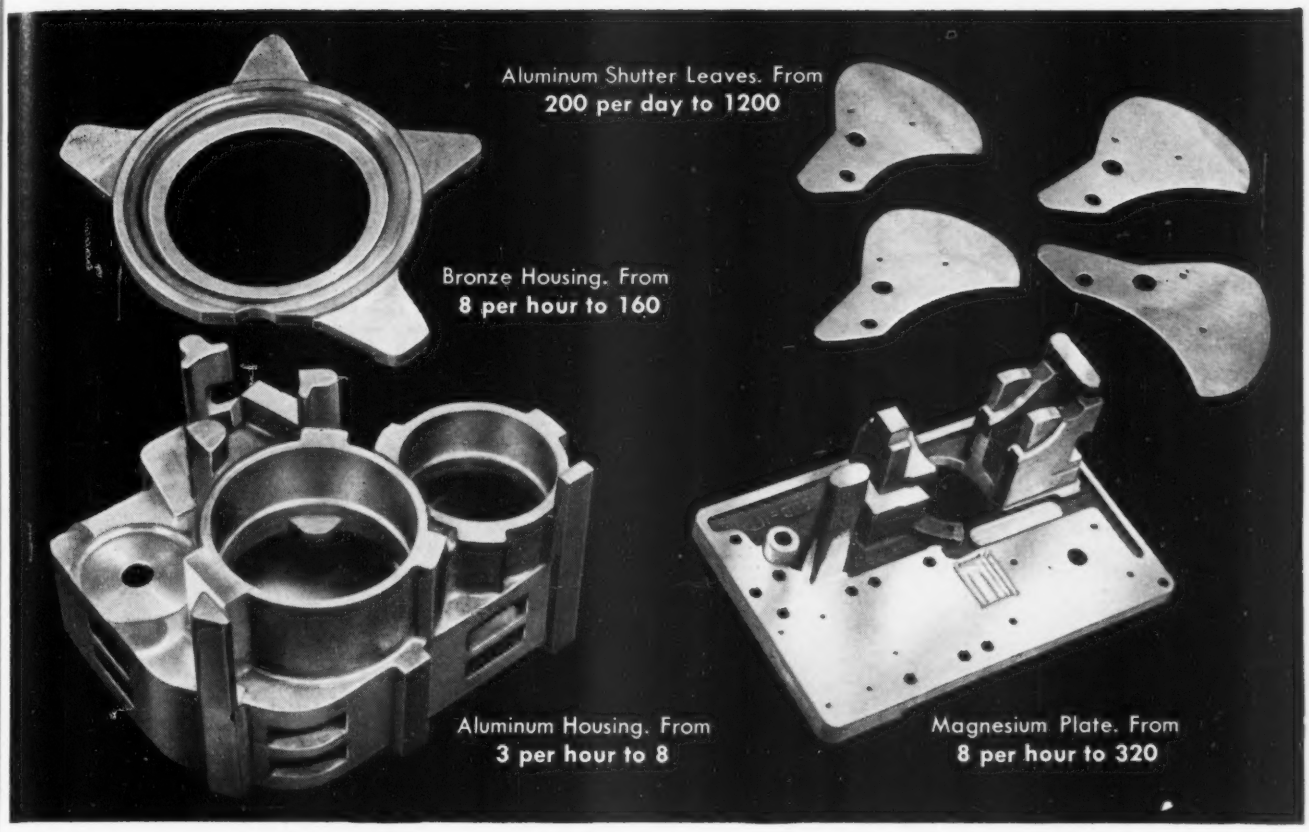
Murray-Way's Automatic Equipment, thorough experience and expert engineering can save YOU money on YOUR polishing, buffing, grinding or filtering operations. Why not give us a call . . . JOrdan 4-6890 Detroit, or write for our complete, illustrated Micro-Polish Brochure.

MURRAY WAY

MURRAY-WAY CORPORATION

P. O. BOX 180, MAPLE ROAD EAST • BIRMINGHAM, MICH.

Polishing, Buffing, Grinding, Filtering Equipment that automatically cuts your costs.



Camera Maker finds...

HONITE Barrel Finishing Saves $25,000 in 3 Months!

Fairchild Camera and Instrument Corp., Syosset, N.Y., cut finishing time on a variety of parts up to 3900% when they switched to the HONITE Barrel Finishing Method. And the savings thus effected paid for $25,000 worth of barrel finishing equipment in just 3 months!

The parts shown above were formerly deburred and finished by hand—a slow, costly job. Now, with the HONITE Barrel Finishing Method costs have been cut to the bone, with better, more consistent finishes. The company deburrs and finishes an average of 150 different lots of parts a week—has found that HONITE Barrel Finishing Methods will do a perfect job on everything from tiny washers and hair-thin shutter leaves to 32-pound bull gears, and even on pieces with tolerances of less than .0002"!

Your HONITE Sales Engineer or nearby HONITE distributor will show you how *you* can increase production and cut costs, too. Call him today!

Honite BRAND

MINNESOTA MINING AND MFG. CO.
Dept. MF-15, St. Paul 6, Minn.

- ☐ Send me complete printed story on Fairchild Camera operation
- ☐ Send me free copy of "3M Barrel Finishing" Manual
- ☐ I'd like to talk with a HONITE Sales Engineer

Name..... Title.....

Company.....

Address.....

City..... Zone.... State.....

Type of product to be finished.....

3M COMPANY

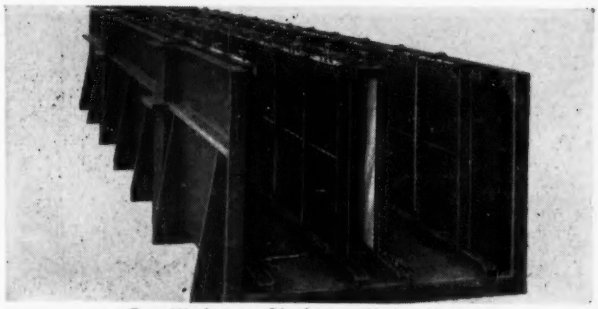
Made in U.S.A. by Minnesota Mining and Mfg. Co. General Offices: St. Paul 6, Minn. In Canada: London, Ont., Can. Export: 122 E. 42nd St., New York City. Makers of "Scotch" Pressure-Sensitive Tapes, "Scotch" Brand Magnetic Tape, "3M" Adhesives, "Underseal" Rubberized Coating, "Scotchlite" Reflective Sheeting, "Safety-Walk" Non-slip Surfacing.

• A remarkable advancement in electroplating, Diaphragm Systems, engineered and installed by ARco have created a new high standard in plating production and quality.

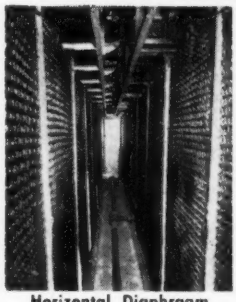
Simply, economically installed, Diaphragm Systems efficiently segregate the anolyte from the catholyte through canvas barriers between anode and cathode compartments.

This ARco electroplating method, combined with ARco Rubber Lined Tanks and planned solution circulation, filters metallic insolubles from outside sources.

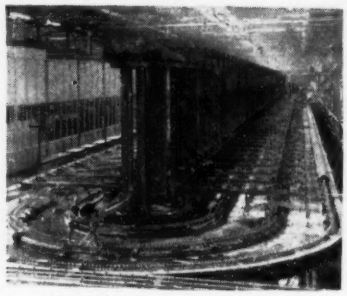
To reduce costly buffing due to roughness . . . prevent rejects resulting from thin spots . . . have an ARco engineer show you how simply Diaphragm Systems can save time, materials . . . and customers . . . for you.



Two Work Lane Diaphragm Plating Tank



Horizontal Diaphragm Installation



Vertical Diaphragm Installation

For uniformly high quality and economy in plating . . .

DIAPHRAGM SYSTEMS *and* RUBBER LINED TANKS *by* ARco

• ARco fabricated and insulated Diaphragm Plating Tank, return bend type.

GET THIS VITAL PLATING INFORMATION...SEND COUPON TODAY!

"Diaphragm Tanks Promote Plating Progress." This explanatory, illustrated booklet is yours without obligation. Send for it today!

AUTOMOTIVE RUBBER COMPANY, INC.
12572 Beech Road at P. M. R. R.
Detroit 39, Michigan

Please rush me_____copies of your "Diaphragm Tanks Promote Plating Progress."

☐ Have your representative call on us.

Name_____

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Licensed Saran Applicators

Anything can be covered with rubber — by ARco

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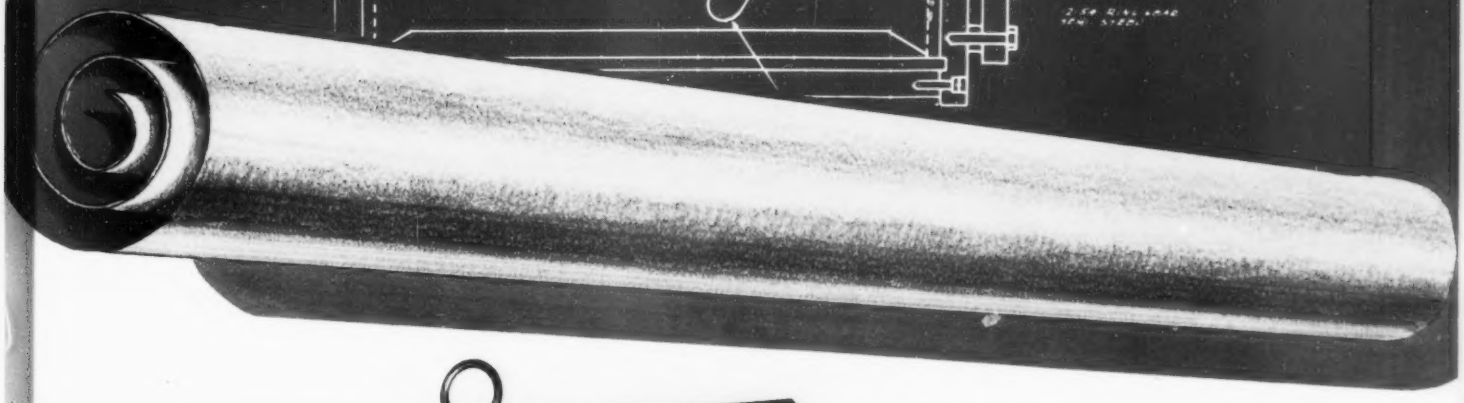
UDYLITE ANNOUNCES

A NEW, SUPERIOR BARREL PLATING CYLINDER

MADE OF TEMPRON

HARD RUBBER



WORLDS' LARGEST PLATING SUPPLIER

1. Withstands, *even under load,* the highest temperatures used in plating.

2. Withstands stronger acids.

3. Has greater resistance to abrasion.

4. Can be used effectively through the entire plating cycle.

ANOTHER UDYLITE FIRST!

After months of research and testing in actual production, Udylite is proud to present a new plating barrel made of Tempron hard rubber with greater efficiency and longer life than ever before offered in plating barrels.

Users of horizontal plating barrels have for years desired a cylinder made of such a material that would withstand the highest plating temperatures. Other requirements called for a high chemical resistance to a wide variety of corrosive solutions, strength to handle heavy loads and economy of a material that would perform satisfactorily through the complete cycle of operations.

Such a material was found in Tempron hard rubber. It resists most inorganic chemicals and it also has good resistance to many organic chemicals which attack hard rubber, soft rubber and plastics.

Using this material, Udylite's design (Patent pending) and construction now give all the features long desired by the plating industry. Udylite's new construction with its inter-locking panels and ribs gives the advantage of "one-piece" construction plus the added feature that the panels, ribs, rails and cylinder heads are individually replaceable. This construction also keeps the barrel in alignment even when subjected to high temperatures and heavy loads.

Udylite Tempron cylinders are so designed that they can replace existing types of cylinders in Udylite Barrel equipment. Udylite Tempron barrel cylinders are available in 24″, 30″, 36″ and 42″ lengths, all with 14″ diameters, and the Udylite standard wide selection of perforation sizes.

CHEMICAL RESISTANCE OF TEMPRON HARD RUBBER

CHEMICAL	Conc. %	Ace Tempron 77°F.	158°F.	212°F.	CHEMICAL	Conc. %	Ace Tempron 77°F.	158°F.	212°F.
INORGANIC					**ORGANIC (cont'd)**				
Hydrochloric Acid	38	S	S	S	Pyridine	100	L	—	—
Sulphuric Acid	50	S	S	S	Gasoline	100	S	—	—
Phosphoric Acid	85	S	S	S	Ethyl Acetate	100	S	—	—
Hydrofluoric Acid	50	L	L	—	Diethyl Ether	100	S	—	—
Nitric Acid	20	—	X	X	Hexane	100	S	S	—
Sodium Hydroxide	20	S	S	S	Benzene	100	S	—	—
Ammonium Hydroxide	28	S	—	—	Toluene	100	S	—	—
Sodium Chloride (Brine)	Sat.	S	S	S	Carbon Tetrachloride	100	S	—	—
Ferric Chloride	Sat.	S	S	S	Ethylene Dichloride	100	L	—	—
Stannous Chloride	Sat.	S	S	S	Chlorobenzene	100	S	—	—
					Acetone	100	S	—	—
ORGANIC					Methyl Ethyl Ketone	100	S	—	—
Acetic Acid	98	S	S	L	Carbon Disulfide	100	L	—	—
Ethylene Glycol	100	S	S	S	Acrylonitrile	100	S	—	—
Formaldehyde	100	S	S	S	Nitrobenzene	100	S	—	—
Benzaldehyde	100	S	X	X	Phenol	10	S	1	—
Aniline	100	S	X	X	Cresylic Acid	100	S	—	—

CODE: S—Satisfactory L—Satisfactory, limited service X—Not recommended

If you are interested in receiving a sample of Tempron hard rubber for a test in your solutions, send your request today to—

THE Udylite CORPORATION
DETROIT 11, MICHIGAN

CALL IN YOUR UDYLITE TECHNICAL MAN TODAY FOR FURTHER INFORMATION OR WRITE DIRECT

WYANDOTTE ANNOUNCES

a superior electrocleaner for nonferrous metals in automatics or hand lines

Laboratory and production tests prove that Wyandotte's new electrocleaner, LECTRITE-NF, improves results, cuts costs! It does an outstanding job on nonferrous metals, especially brass, and provides the following advantages:

INHIBITED

to prevent etching, staining, excessive oxidation, clouded plate — during cleaning as well as in long transfers.

FORTIFIED

for exceptionally high detergency, soil tolerance, and long use-life which insures lower use-cost for you.

BALANCED

for fast and complete wetting, free rinsing, controlled foam blanket which assures uniform, more efficient processing.

VERSATILE

New LECTRITE-NF is effective in hard or soft water, on brass, copper, copper alloys, zinc-base diecastings, and other special alloys. For single-tank reverse-current electrocleaning, or where two-stage direct and reverse cleaning is employed.

Wyandotte offers a complete line of performance-proved metal cleaners, phosphatizers, paint strippers, and related products. Each is specially prepared to give optimum results at lowest use-cost. Write today, stating your metal-cleaning problem or application, for complete facts and demonstration. *Wyandotte Chemicals Corporation, Wyandotte, Mich. Also Los Nietos, Calif.*

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CHEMICALS

Helpful service representatives in 138 cities in the United States and Canada

MAIL NOW FOR DATA AND DEMONSTRATION

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Wyandotte, Michigan

☐ Send more data on the use of new LECTRITE-NF.

☐ Have representative call.

Name_____

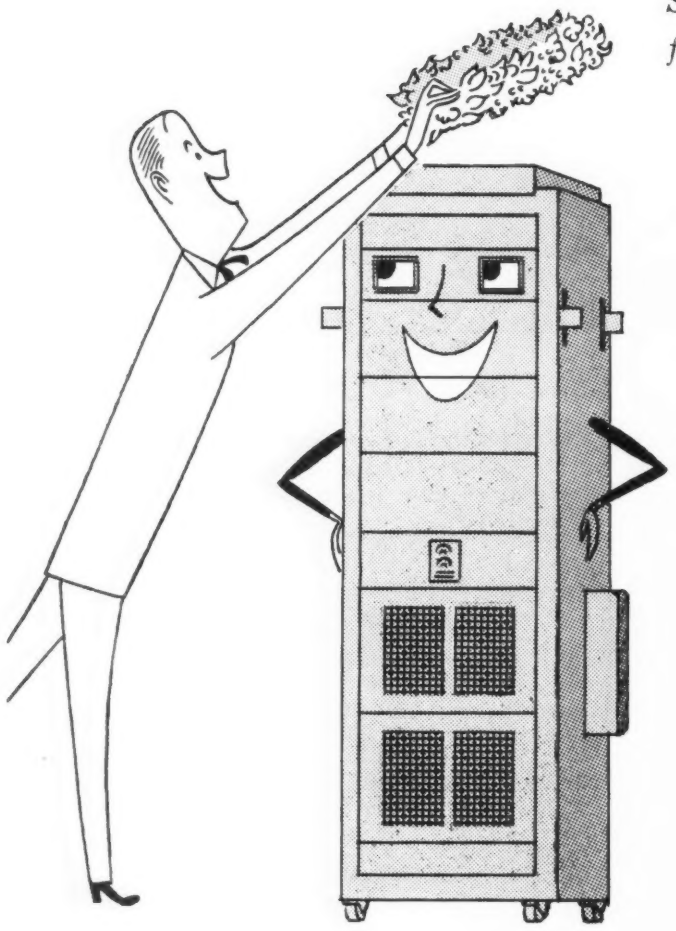
Firm_____

Address_____

City_____ Zone____ State_____

DID YOU KNOW?

NEARLY EVERY FEATURE NOW AVAILABLE ON ELECTROPLATING RECTIFIERS WAS ORIGINATED BY GREEN ELECTRIC — AND MOST OF THESE OVER A DOZEN YEARS AGO



Some of the standard and special features in Munning-Green Rectifiers:

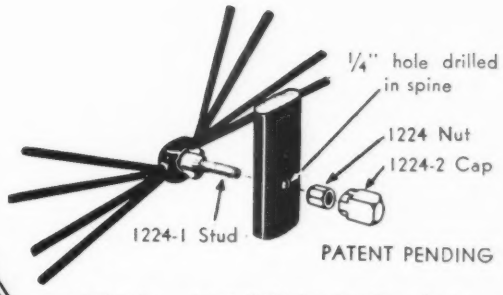
- Skyscraper cabinets to save floor space
- Caster mounting to simplify installation
- Meters and lamps at eye level
- Controls and pushbuttons at hand level
- Twin pairs of output terminals
- Automatic current overload protection
- High temperature visual and audible warning signals
- High temperature automatic shutdown
- Anti-single-phase protection
- Downdraft cooling
- "L" circuit for low ripple and high efficiency
- Dual input
- Dual, triple and quadruple output
- Pushbutton remote control
- Automatic voltage stabilization
- Automatic current stabilization
- Automatic ampere-hour control
- Automatic time control
- Factory-tested at full load
- Detailed instruction book
- Unconditional two-year guarantee

MUNNING-GREEN RECTIFIERS
. . . Best in the World!

EXCLUSIVE SOURCE:
MUNNING & MUNNING INC.
202-208 EMMET STREET, NEWARK, N. J.
(Sales offices and distributors in principal cities)

The Right Plating Racks when you NEED them —at LOW cost!

Thinker Boy 30" Spine complete only $2.85



PATENT PENDING

Just drill holes and install Thinker Boy Tips where you want them in Thinker Boy Rack Spines.

You have completely insulated racks designed for the job in minutes. No dipping. No baking. No waiting. The only tools you need are a drill and pliers.

Think of the advantages you get with Thinker Boy

No Waiting—You can have the right racks for every job when you need them. Get all jobs out on schedule without excessive costs from inefficient racking.

Cut Rack Costs—Thinker Boys don't become useless. You can quickly change tips or adjust spacing to rack different articles. Thinker Boy Spines are mass produced and cost so little you can have spines with many different spacings.

Adaptability—You can quickly and easily adjust each Thinker Boy Tip to hold an amazing variety of articles.

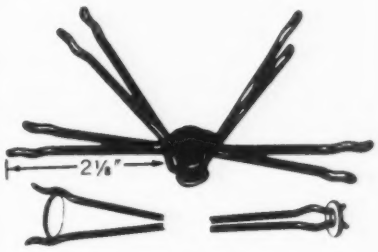
Reduce Handling Time—You can couple the spines with Thinker Boy Cross Members for increased handling efficiency.

Unlimited Flexibility—You can quickly assemble racks of many different types and styles with a small assortment of Thinker Boy Sections.

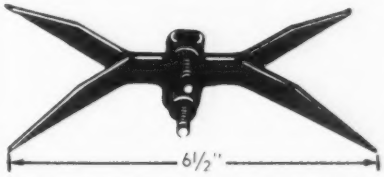
You can save money by getting acquainted with Thinker Boy. The new Thinker Boy Catalog is a veritable road map to increased racking efficiency and reduced racking costs. Send for your copy, NOW. Just mail the handy coupon.

Four Most Popular Thinker Boy Tips

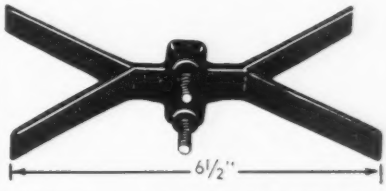
All Thinker Boy Tips are easily adjusted to hold different articles.



RS-207. Same design as the popular Style 1 Utility Tip. Has 8 prongs arranged in 4 pairs—formed to hold objects under spring tension from either inside or outside. Wire sizes: 1/16", .072" and .080". Universal Plastic Coated.



FS-102. Same design as the Style 4 Utility Tip, except has double knurler. 1/16" x 5/8" phosphor bronze. Universal Plastic Coated.



FS-101. Same design as Style 3 Utility Tip, except has double knurler. Excellent for racking objects that tend to wobble. Square ends are easily shaped when necessary. 1/16"x5/8" phosphor bronze. Universal Plastic Coated.

RS-201. Same as Style 2 Utility Tip. Wire sizes: 1/16", 3/32", .114" and 1/8". Universal Plastic Coated.

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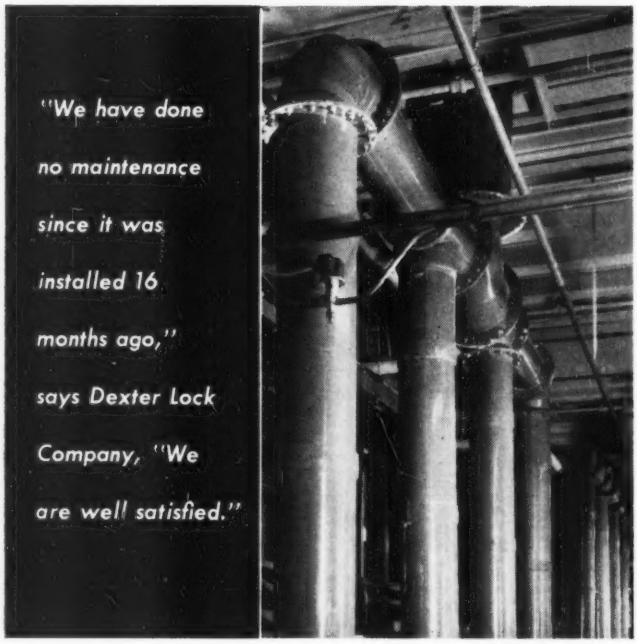

Dexter Lock's huge risers of Boltaron 6200 are shown off the anodizing tanks, going up and through the roof where other Boltaron ducts carry fumes into exhaust fan. "We are well satisfied with the Boltaron 6200 duct system and the service we have received from the Boltaron Fabricator, Carpart Corp., Owosso, Mich.," reported the Company spokesman.

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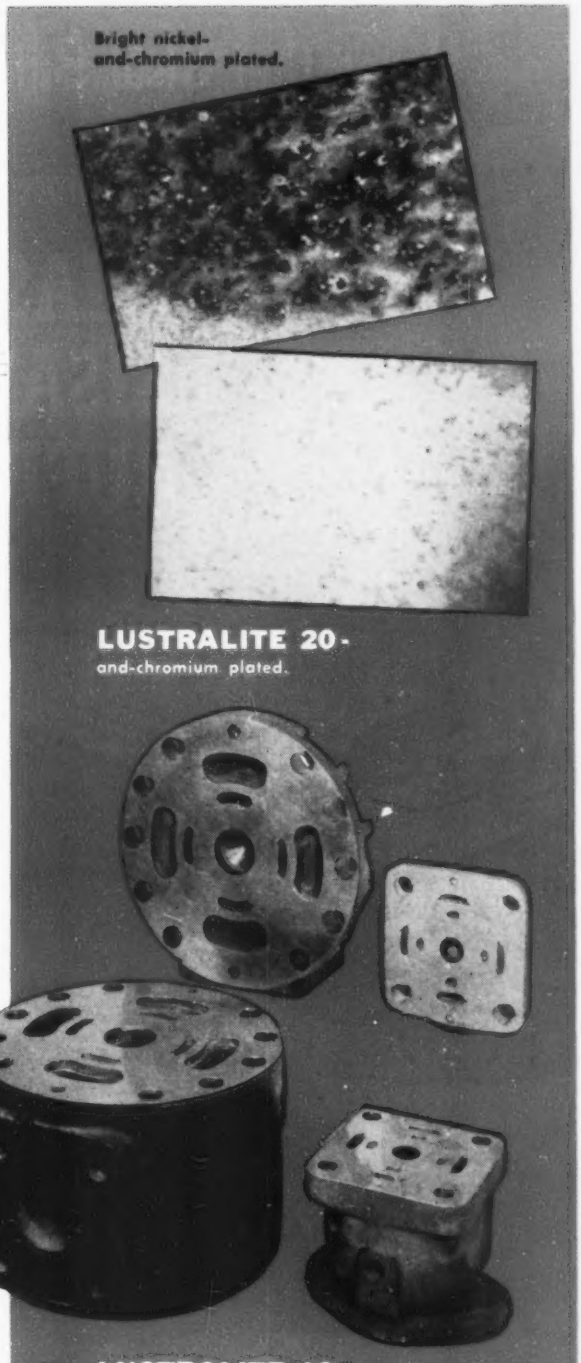

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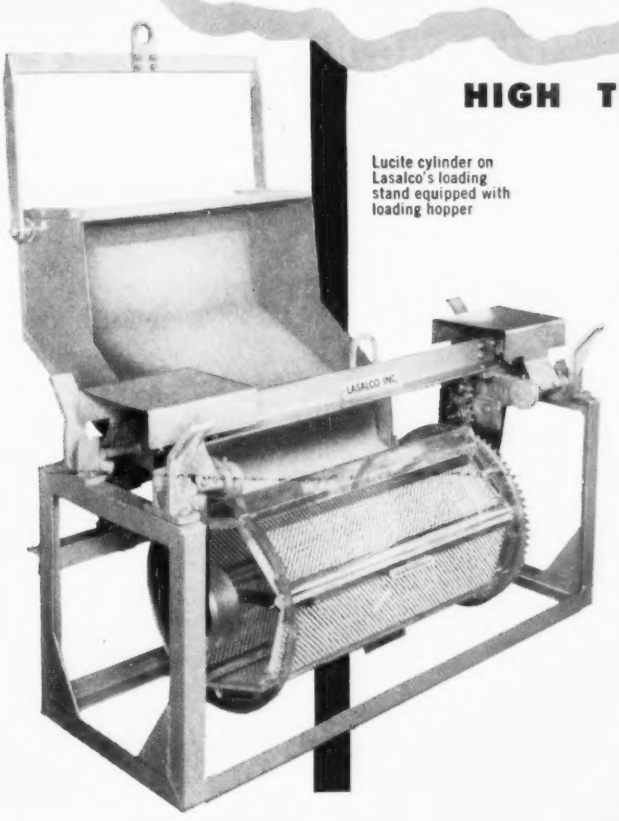

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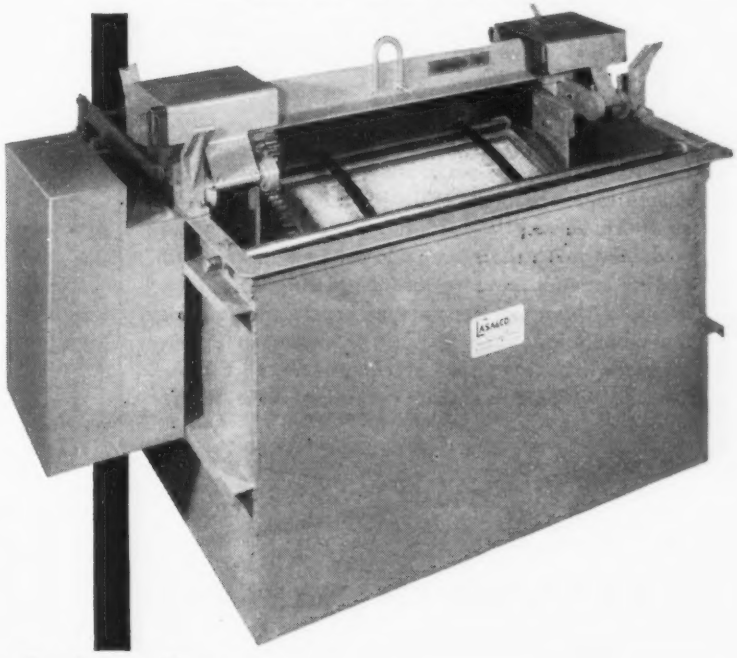

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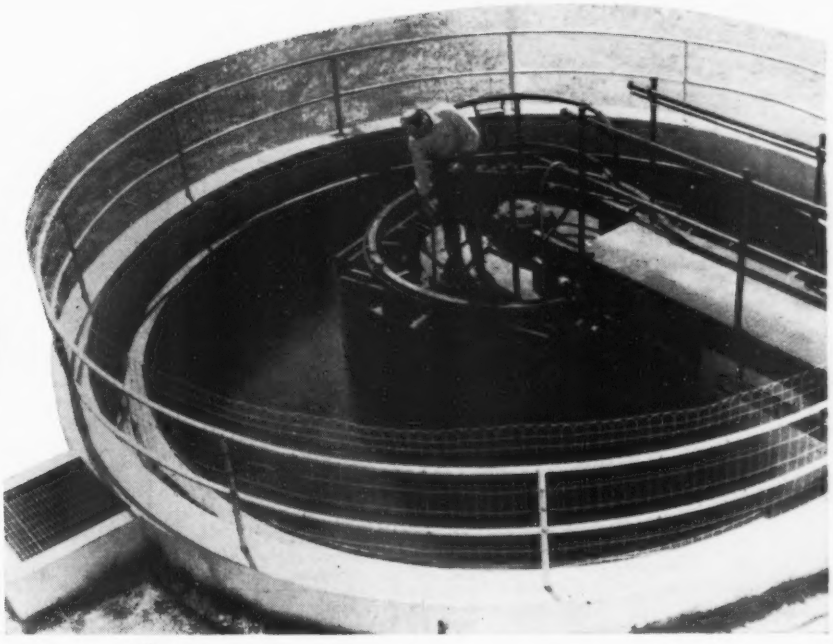

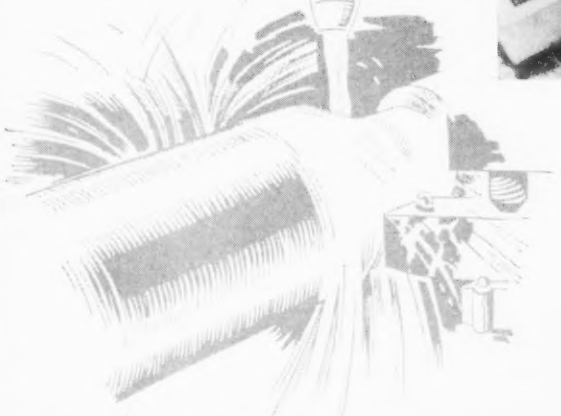

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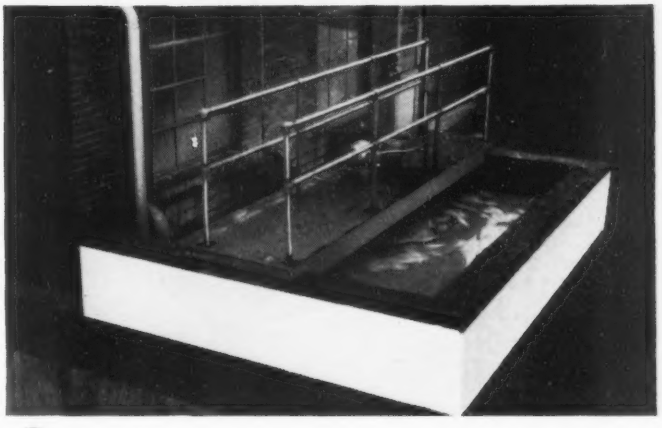

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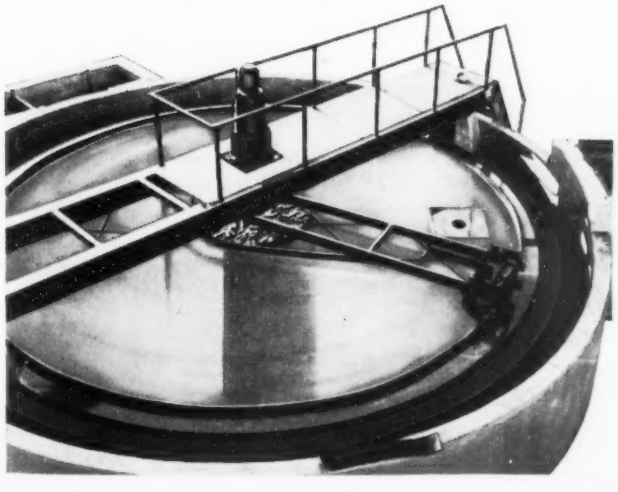

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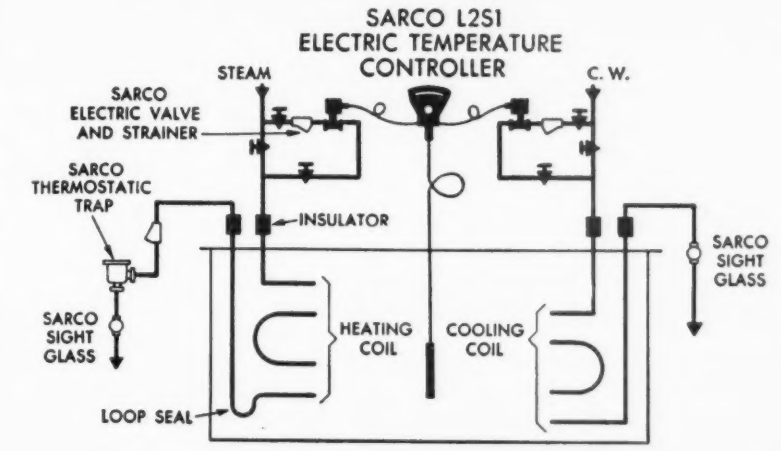
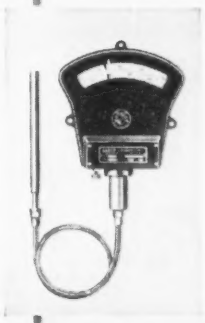
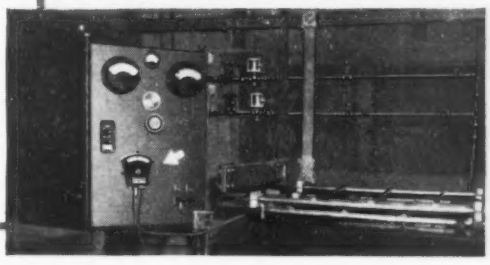


One Sarco L2SI Electric Temperature Controller provides automatic control for *both heating and cooling* of anodizing and high speed nickel and chrome tanks.



Sarco Electric Temperature Controllers hold baths to within plus-minus 1°F. Temperature setting is easily changed by turning only one knob.

Brunswick Radio Corp., Richmond, Indiana, enjoys all the benefits of automatic temperature control in its chromium plating operation with a Sarco Electric Temperature Controller.



It costs less than you think to install Sarco Electric Temperature Controls

. . . and you profit 4 ways!

Some platers believe that automatic temperature controls are expensive. Actually, Sarco automatic controls can be bought for as little as $130 a tank . . . *and often pay for themselves in just weeks!*

Here's How

Platers know that uneven bath temperature is one of the major causes of rejects and poor product quality. Many of them also know that a good deal of steam is wasted by manual attempts to keep temperatures where they belong. Furthermore, time lost in making these temperature adjustments with hand valves can be used more profitably in serving additional tanks.

With Sarco automatic controls desired temperatures are adjusted quickly by turning *one* knob and once adjusted stay where you want them . . . automatically. You profit 4 ways because:

- You improve product quality
- You lower rejects
- You save man-hours
- You save steam and solutions

Call in the nearby Sarco representative and have him show you just how little it costs to get all these benefits. For complete information on the advantages of Sarco plating controls, write for Technical Bulletin No. 6.

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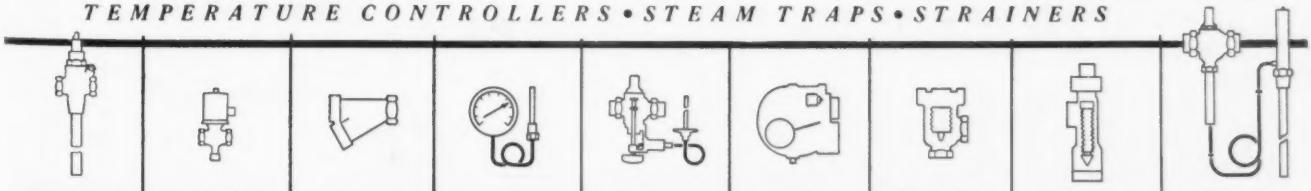

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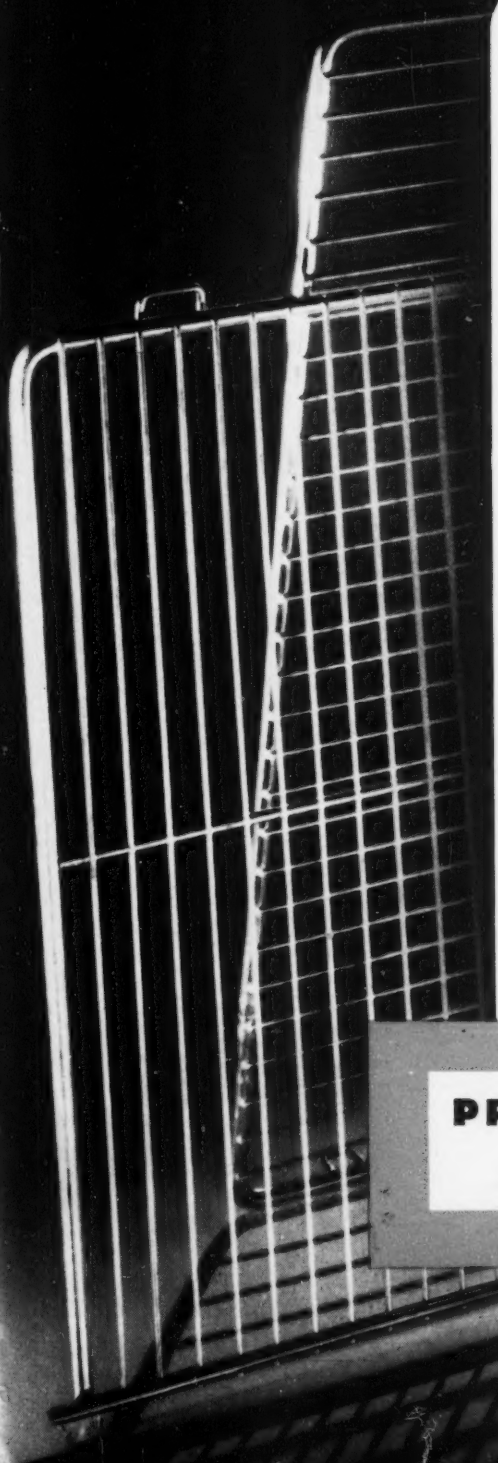
...the LAST WORD in positive protection for Cadmium, Zinc and Aluminum



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a dry powder for bright or bronze phase on zinc and bronze phase on cadmium. No carboys needed . . . mix with water and acid.

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inexpensive dark film of low reflecting power. A high workable liquid for bronze on cadmium or zinc.

PROSEAL D-33
single bright dip for good corrosion protection for plated cadmium. Has no color or iridescence.

PROSEAL #17
an inexpensive liquid producing a highly protective film. Has little iridescence when leached with Proseal #2A or 2B.

PROSEAL #10
olive drab variety for cadmium. Meets all specifications for chrome type protective film.

PROSEAL D-32
single bright dip for plated zinc. Least expensive product of its type on the market.

Write for details on PROSEAL #16—a new chromate film for *outstanding* performance on aluminum and its alloys.

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METAL FINISHING

JANUARY, 1955 VOLUME 53 • NUMBER 1

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The use of potassium oxalate as a complexing agent in the boric acid analysis in nickel solutions.

Recently completed research work discloses satisfactory processes of descaling and pickling titanium.

A method for the determination of alkali metals in phosphating solutions and cyanide plating baths.

The ultrasonic method of metal cleaning answers the difficult problem of making the cleaning complete.

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The Outlook for 1955

January is the time for forecasts and a brief glance at what is in store for the metal finisher is in order at this time.

As regards supplies, his position might be considered slightly better than during the past year. For a while, strikes in the copper refineries were followed by a tight market which showed stocks of the red metal dropping to dangerous lows. However, settlement was in time to prevent real hardship from developing among platers, except those who, despite past experience, still continue to work from hand to mouth. A contributing factor also was prompt government action in refilling the pipeline by authorizing the sale of 51,500 tons of refined copper already accumulated under the Defense Production Act, or scheduled for delivery.

Zinc, tin, cadmium, lead, aluminum and steel are in excellent supply and bid fair to remain that way. Were it not for the continuing shortage of nickel anodes and salts, supply problems would be really non-existent. The industry is resigned to the fact that the nickel shortage is going to be with us for quite a while yet and is operating accordingly. There have been objections that distribution, at times, has been somewhat less than equitable and these complaints have been reinforced with evidence that some new, large nickel plating installations have been put into operation, presumably diverting nickel from established users. In some quarters, demands are even being made that government controls be reimposed on nickel allocations. On the whole, however, sufficient metal has been entering the market so that no platers have been forced to go out of business for this reason, so far as we are aware, and it is expected that supplies will show a slight improvement this year.

The slight upswing in general business conditions, appearing toward the end of last year, should continue and further advances would surprise no one. Competition, of course, is also increasing at a rapid rate and, in many sections of the country, platers have been complaining that prices are being cut even below the break-even point. This situation is not a new one for the job and contract finisher and he will meet it as he has often done in years gone by, generally by waiting until the price cutter cuts his own financial throat.

We would hazard the opinion that a fairly normal year is ahead of us and the outlook, on the whole, appears quite favorable. Our main hope is for peace.

Nathaniel Hall

Technical Developments of 1954

By Nathaniel Hall, *Technical Editor*

Cleaning

IN the field of cleaning there were no developments during 1954 which could be considered outstanding. Cleaning with organic solvents was the subject of only two articles, one by Halls[1] who compared the *characteristics of solvents* and discussed the maintenance of efficiency in trichlorethylene degreasing operations, and the other by Sherwood[2] on the use of *emulsifiable solvent cleaners* with emphasis on composition, properties, advantages and drawbacks. Only two patents were granted, both on *degreasing equipment*, to Kearney[3] and to Lebus.[4]

Three articles on alkaline cleaning were worthy of note. Linford & Feder[5] surveyed the literature on the *effect of oxide films on subsequent electrodeposits*. Haas[6] laid out flow sheets for *preparing lead alloys, pewter and brittania for plating*, and Graham[7] described *cleaning procedures* found suitable for steel, buffed copper and buffed nickel prior to nickel plating, a peel test being employed to determine the adhesion. Patents consisted of a *polyphosphate cleaning compound* containing di-butyl thiourea to inhibit tarnishing of copper, issued to Sweet & Mead[8] and the use of assymetric *reversing electric current* in a cleaning solution, claimed by Emmett & Petering.[9]

Abrasive blasting was covered by only two articles in which Stine differentiated between the various types of *machines and abrasives*[10] and described surface preparation of metals by the process prior to plating.[11] However, the inventors were quite busy, equipment being patented by Lawrence[12] and by Powell & Brunner[13] for *dry blasting*, while patents granted to Jewett[14] and to Gladfelter & Croft[15] covered *wet or liquid blasting*. Other patents covered a *sand blast gun and nozzle*,[16] a collapsible *valve for a sandblast hose*[17] and a *cleaning cabinet*.[18] In addition to improvements in equipment, the patent literature also produced a few on the abrasives, an improved *steel shot* being claimed by Hutchinson[19] and a method of *producing it from wire on a continuous basis* as required, disclosed by Gladfelter.[20] Also a *washing device* for sand abrasive[21] and a method of *separating waste particles* from the abrasive.[22]

Pickling

Pickling was a popular subject during the past year, although most of the developments arrived by way of the Patent Office rather than the technical press. As was to be expected, much work was done on steel, the most interesting in our opinion being an investigation by Cardwell[23] which showed that the crystal structure of steel has a considerable influence on its *corrodibility in inhibited HCl;* the more complete the annealing, as measured by the resolution of the pearlite, the lower was the corrodibility. In another valuable study, Peterson, Nichols & McDevit[24] found that the *use of cyanide to neutralize steel* after pickling resulted in cleaner sheets than was possible with other alkalies. The surface was found to resist corrosion and provide an excellent pretreatment for galvanizing and enamelling.

Dubin & Locke[25] showed how *in-line pickling* installations aided in the continuous production of wire, aside from which only the patent literature had anything further to offer on continuous pickling. Vonada patented a process for continuously *pickling and flash tin coating steel strip*,[26] reminiscent of the old Bullard-Dunn process in that high silicon-iron anodes are used with some tin. Martin[27] disclosed a *pickling process* in which portions of the acid are continuously withdrawn, evaporated to precipitate excess ferrous sulfate, and returned to the pickling tank after adding fresh acid. Other disclosures were by Barnes,[28] who claimed a method of *recirculating* a *pickling solution;* by McHenry[29] who suggested a *hollow hold-down roll* for strip, filled with water under pressure, and by Dunlevy, Frick & Shoemaker,[30] who claimed a *molten bath* for continuously cleaning and pickling steel strip.

On the subject of solutions for scale removal, two fused bath methods were noteworthy for their similarity. Noble, Pottberg & Tainton[31] were issued a patent on a *fused alkali bath* containing oxygen in gaseous form, while Spence, Johnson & Osborne[32] received one on a method of *regenerating the fused caustic-oxidizing agent bath* by bubbling oxygen through it. The use of *ammonium bisulfate* was claimed by Brundin as a pickling agent[33] and, surprisingly, only two *pickling inhibitor* patents were granted during the year, both to Chester & Irwin.[34]

Pickling of metals other than steel received scant attention in the literature. *Titanium* was covered by a patent to Mellgren & Moles[35] for a molten alkali metal sulfide to loosen scale and one short article in which Bomberger, Vordahl & Finlay[36] suggested that *embrittlement could be avoided* by maintaining the concentration of nitric acid in the standard nitric-hydrofluoric acid pickle above about 20%. *Magnesium* could be pickled prior to spot welding in a mixture of polystyrene sulfonic acid, aryl sulfonic acid and a sequestrant, according to McDonald & Hawley[37] and, in the only reportable article on *stainless steel*, Spencer[38]

surveyed the commercial processes with special emphasis on acid and molten alkali baths.

Polishing

Mechanical

The past year indicated more activity in this phase of finishing than we have seen in a long time. Noteworthy among the articles was the attempt to correlate *metallurgical hardness and buffability* by Faint & Modjeska.[39] The results were inconclusive but the authors must be complimented for a pioneering attempt in a relatively untouched field of research. Another item worthy of review was a study by Kahan, Macchia & Fairbank[40] on the effect of *surface finishing* of nonferrous base metals on the *protective value* of plated coatings. Other articles culled from the literature included a description by Taylor[41] of an *automatic set-up* used in conjunction with hand buffing for aluminum castings of intricate shape, and a survey by Wernick & Pinner[42] of *polishing procedures* for this same metal.

Two unique patents were issued, one to Balz & Castle[43] on a method in which the racked parts are submerged in a mass of abrasive and *oscillated* therein, the other to Cuppers[44] for a method in which a workholding fixture is submerged in a *rotating container of abrasive*. Other patents consisted of a *motor driven polisher*, claimed by More[45] and a dust collector *hood construction* disclosed by Jaron.[46]

Buffing compounds received more than slight treatment. Twyning[47] was responsible for one of the very rare articles on the technology of *liquid buffing compositions* and four patents were granted, a control and moving mechanism for *spray application* of liquid buffing compounds, disclosed by Burt,[48] a *water-dispersable buffing composition*, claimed by Young,[49] a *lubricant for polishing wheel surfaces* patented by Fiser,[50] and the use of *zirconium silicate* of specified particle size, claimed by Coffeen[51] as a polishing abrasive.

Buffing wheels were represented by patents issued to Busch & Kurtzwarth,[52] Churchill,[53] and Hawkinson.[54] Most of the activity in *power brushing* was due to Peterson, who presented a guide to proper selection for finishing different metals,[55] disclosed a process for scale removal from sheet, using the *particles of scale as the abrasive*,[56] claimed a *bristle brush* with a nylon coating incorporating fine abrasive and filler[57] and, together with Nelson, patented a *rotary brushing machine* with a universal workpiece holder.[58] *A power brushing machine* was also patented by McGibbon.[59]

Belt polishing was covered by one article, in which Johnson[60] offered basic information on the characteristics of *contact wheels*. Patents consisted of *flexible abrasive belts*, issued to Buckner[61] and to Walters,[62] *equipment* claimed by McGuire,[63] and by Coe & Dym,[64] also by Riedesel, Miller & Martin[65] for belt polishing the *interior surfaces of holloware*.

Electrolytic

In an important contribution to the *theory of electropolishing*, Wagner[66] described the characteristics of the ideal process and derived formulas for decrease in surface roughness as a function of the recess depth, amount of metal dissolved per unit surface area and product of current density and time. An article by Steer[67] suggested the use of this process for *controlled removal of metal* — electromachining and superfinishing, and Pinner[68] presented a *history of the development* of electrolytic treatment. Other articles included a comparison of the *reflective properties* of stainless steel polished electrolytically and mechanically, by Riley,[69] and a description of *servo control* in the electropolishing of fine wire by Korbelak & Rively.[70] One patent was issued on an apparatus for electropolishing the *interior of containers*, claimed by Jumer.[71]

Tajima & Mori[72] investigated a number of solutions for electropolishing *titanium*, based on hydrofluoric acid plus other acids. They found that HF with additions of chromic, phosphoric, methanol, and acetic anhydride, gave satisfactory results. New electrolyte formulations were also disclosed in the patent literature, *alternating current* in a solution of an aliphatic carboxylic acid and sulfuric acid, using tantalum electrodes, by Espy;[73] addition of *humic acid* and alkaline salts of same to the sulfuric-phosphoric bath for *steel and stainless steel*, by Gamble;[74] solutions of hydrofluoric acid with boric, chromic, and sulfamic acids for *aluminum*, by Hesch;[75] ethylene glycol with sulfuric acid plus a small amount of HCl for *cobalt, chromium and molybdenum*, by Prosen;[76] and an anhydrous electrolyte of a nitrogenous base for *steel, copper and brass*, by McLeod & Wernlund.[77]

Chemical

As usual, most of the work in this field was in connection with aluminum, for which four solutions were patented. DuFresne & Swihart[78] covered a *caustic soda bath* with the addition of gluconate and a large amount of an oxidizing agent, and another *alkaline bath* was claimed by Ferguson,[79] employing hot hydroxide and nitrite. Solutions of *polystyrene sulfonic acid*, containing HF, H_3PO_4, an aryl sulfonic acid and a sequestrant were disclosed by McDonald,[80] and hot concentrated *nitric-phosphoric acid* plus silicic acid was proposed by Spooner.[81]

The patent pages also disclosed processes for bright dipping or chemical polishing other metals. An anhydrous bath of meta- or pyrophosphoric acid containing tartaric, sulfuric acid, or ferrous sulfate, to be operated at 120-260°C., was claimed for *steel and aluminum* by Bo-Shin Ro.[82] A dilute aqueous solution of HNO_3, HCl, HF and H_2SO_4 plus an organic compound of the alkaloid class was proposed for the *straight chromium type stainless metals* by Hayes & Lomakin.[83] According to Simon,[84] *lead* could be polished in a solution of acetic acid and hydrogen peroxide, followed by an acetic acid rinse; a solution for *nickel* containing acetic acid, nitric acid and hydrochloric acid was suggested by Fox;[85] and *zinc* was covered in a patent to Wick for a solution to be operated at room temperature and containing chromic and boric acids, in the amount of 250 and 12 g./L. respectively.[86]

For those interested in obtaining background information on the various *solutions and their applications*, including the theory of electropolishing, we suggest an informative article by Pinner.[87]

Barrel Finishing

There was sufficient activity in connection with this method of finishing during the past year to warrant

separate treatment rather than inclusion among the other sections of this review. Patents consisted of a *flexible burnishing barrel* which deflects the work during rotation, invented by LaMonica[88] and a process for *tumbling bearings*, claimed by Gillette & Burroughs.[89] Articles of interest included a description by Maynes[90] of precision *barrel finishing procedures;* a discussion by Kohler[91] of some considerations of importance and the *mechanism of ball burnishing;* the use of a slurry of Vienna lime and other suspended media for *producing bright surfaces*, covered by Beaver;[92] and details by Chase[93] on deburring of *machined parts* by wet tumbling.

Barrel plating was the subject of two articles and two patents. Halls described the *technical problems* experienced in barrel plating and their solution in one article[94] and discussed some of the *general considerations* involved in the employment of the process in another.[95] The patents covered a *cylinder construction*, claimed by Colclesser,[96] and a *combination barrel and rack plating unit*, disclosed by Barr & Knecht.[97]

Aluminum - Plating and Anodizing

Anodizing of aluminum appears to have occupied the attention of more authors and inventors than any other single phase of metal finishing in recent times, and the past year was no exception. As regards fundamentals, Mason & Fowle[98] investigated the factors affecting the *rate of solution of the anodic oxide coatings* as they are being formed in the sulfuric acid baths. Conditions favoring high coating ratios or thick, hard, abrasion resistant coatings were found to be low temperature, high current density and addition of substances such as oxalic acid. Studies were also made by Hunter & Fowle along the lines of determining the *barrier layer thickness* of such coatings.[99] The same investigators also studied the effect of *variations in electrolyte* and forming conditions on the formation of the porous type of anodic oxide coatings.[100]

Among the other articles of interest were a description by Brace[101] of the different methods for producing *hard, thick films*, including a discussion of the investigation by the Aluminium Development Assn. of the microhardness and wear resistance of the coatings. Bratt detailed the considerations involved in *dyeing anodized aluminum* to match a given color[102] and Brink gave operating details and cost breakdowns of the ion-exchange method of *recovering the chromic acid* from this type of anodizing solution.[103]

In the patent field, new anodizing solutions were proposed by a number of inventors. Production of *hard oxide films* in the low temperature sulfuric acid bath was the subject of two patents issued to Burrows.[104] *Flexible film* by anodizing in dilute oxalic acid, followed by immersion at 80-95°C. in oxalic acid was claimed by Young & Hain.[105] *Alternating current* in a sulfuric acid bath containing halogen salts was suggested by Gauthier[106] and a *fused nitrate-nitrite salt bath* by Schaaber.[107].

Other patents included a method of *sealing the film* by treating with a solution of polyacrylic acid and heating below 100°C., claimed by Wood,[108] production of *waxed and colored anodized aluminum* ice cube trays, disclosed by Prance & Reindl,[109] and a method proposed by Johnson[110] for effecting a *two-toned finish* by cutting through the sealed anodic film, then reanodizing and dyeing the second coating.

Little new developed during the year in the methods of *plating on aluminum*, the only new patent being on the addition of hydrous oxide of a metal from the iron group to the *zincate pretreating bath*, granted to Zelley.[111] However, Castle[112] reviewed the *methods and difficulties* involved in depositing coatings on aluminum, while Spooner & Seraphim,[113] who studied the *phosphoric acid anodizing pretreatment* for plating on the light metal, decided the results are better than with the zincate process.

Metallic Coatings

Nickel

The chemical reduction process, more commonly known as *electroless* nickel, maintained the high level of activity first commented upon a year ago. In a comprehensive review, Brenner[114] detailed practically all the information to date on the *development, application and control* of the process, in which he pioneered. MacLean & Karten[115] described a *practical application* of the Brenner-Riddell process to steel bomb fuze components, while West suggested commercial *procedures for coating in bulk* using a barrel,[116] and also described the *ammoniacal bath* for use on non-ferrous metals.[117]

Other descriptive articles were presented by Durkin[118] on the *properties* of electroless nickel deposits, by Gutzeit[119] on the chemistry, characteristics, and uses of an *improved commercial process*, in the development of which he played an important role, and by Gutzeit & Landon,[120] describing a *large scale production plant*. Patents included the use of a nickel salt, hypophosphite, fluoride and a salt of a simple short chain saturated aliphatic dicarboxylic acid, claimed by Gutzeit,[121] a solution for coating *aluminum*, containing nitrate together with the nickel salt and reducer, disclosed by Reschan & Krieg[122] and methods for coating *non-conductors*, which were covered by Gutzeit, Crehan & Krieg.[123, 124, 125]

Electrolytic nickel plating also maintained its dominant position in the literature. Results of investigations were reported by a number of researchers. Ewing et al.[126] reported on his work covering the *effects of lead* in nickel plating baths on the character of the deposit, along with methods for its removal. Curkin & Moeller[127] studies the *stress caused by iron* in the bath and were able to produce regulated levels of residual stress while, on the same subject of stress and cracking of deposits, Such[128] presented methods of determining *internal stress and ductility*. Wesley & Knapp[129] confirmed that *porosity test reagents* can produce pores during the test so that properly produced nickel deposits may be far less porous than previously assumed. The *troubles experienced* in nickel plating, their possible sources, and suggested cures, were tabulated by Stocker, Korbelak & Carrano.[130]

Descriptions of the *sulfamate nickel plating bath*, together with the characteristics of the deposits were offered by Diggin[131, 132] and by Barrett,[133] and the only articles on *bright nickel plating* were a review by Saltonstall[134] of progress with respect to attaining the

desirable properties listed 20 years ago, and a study of the *action of organic compounds* at the surface by Leidheiser,[135] who employed three types of experiments, x-ray diffraction analyses of the deposits, cathode potential studies, and adsorption studies.

Of the patents on *nickel brighteners*, Brown received three, covering esters of polycarboxylic acids,[136], other esters,[137] and coumarin sulfonic acid.[138] Other patents were issued to Passal[139] and to DuRose & Willson.[140]

Chromium

A number of investigations were reported during the year both on the *mechanism of chromium deposition* and on the deposits. Tests with radiosulfur by Sass & Eisler[141] indicated that the sulfate forms a *chromium sulfate complex* in the bath during electrolysis, whose function is to dissolve the basic colloidal compound around the cathode, thus permitting free migration of the hexavalent chromium to the cathode where it may be reduced to the metal. Frolen[142] also attempted to develop a satisfactory *theory concerning the mechanism of deposition*.

Stareck, Seyb & Tulumello[143] were able to obtain *negative or compressive stress* with fine crack-pattern chromium deposits, not previously reported in the literature, and which they explained. The influence of annealing on the *structure and hardness* of the deposits were studied by Brittain & Smith,[144] while Williams & Hammond described a test developed to determine the *adhesion of heavy chromium deposits* up to the tensile strength of the chromium.[145]

Patents consisted of a *trivalent chromium bath* developed by Snavely, Faust & Bride,[146] a chromic acid bath containing *strontium sulfate and alkali metal silicofluoride*, claimed by Stareck & Dow,[147] a *copper-cored-lead anode* disclosed by DeQuasie & Kochs[148] and Geese's device for *spot plating* chromium.[149]

Copper

During 1953, there had been insufficient activity in the literature to warrant separate treatment in our review. However, last year things changed for the better as concerns spreading of information. The researchers accounted for some valuable contributions, of which one especially noteworthy was a study of the *effect of ultrasonic waves*, in which Wolfe et al.[150] found polarization to be markedly reduced in the acid sulfate bath.

In a pair of papers, Ostrow & Nobel described their work on *leveling* in cyanide[151] and acid[152] copper baths, which indicated the possibility of a solution exhibiting leveling merely by a reduction in frequency although the average rms is not reduced. The apparent absence of interest in *diffusion of copper deposits* into zinc base die castings ended with a report by Roberts[153] confirming that polishing of the base prior to plating decreases the diffusion rate but, in addition, the author found that the reduction effect is not very noticeable above about 200°C. Other articles included a discussion of *complex cuprous cyanide compounds* and their chemistry by Gabrielson,[154] and details by Prince[155] on *copper plating troubles*, causes and cures.

A new type of *copper anode*, containing a small amount of phosphorus, was found to practically eliminate anode sludge in acid copper baths. The characteristics were discussed by Nevers, Hungerford & Palmer[156] and patent coverage obtained by Nevers & Palmer.[157] Other patents were issued to Murray[158] for a method of *continuously copper plating steel wire*, and to Norwitz[159] for a contact plating acid copper bath containing a colloid, to be used for *coating aluminum*. Lignin sulfonic acid and its salts plus other organic sulfur compounds were claimed as *brighteners for acid copper baths* by Overcash & Parks,[160] while *brighteners for cyanide baths* were patented by Ostrow,[161] who claimed selenophenols, by Jernstedt[162] on 0.01-0.4 oz./gal. lithium, and by Chester & Irwin.[163]

Other Metals

Tin received very little attention, one patent covering the prevention of defects in *continuous electrotinning* of strip steel by plating at below normal current density in the first pass being disclosed by Howell.[164] One article of interest was a description by Mills & Thwaites[165] of an apparatus for *laboratory scale simulation* of continuous strip plating, which worked very well. There were two articles on *immersion tin*, in one of which Gurnham[166] surveyed commercial practice and, in the other, Weimer & Price[167] compared various methods for producing *immersion deposits on aluminum*.

Zinc plating received even less attention than did tin, articles being completely absent from the technical literature. However, two patents were noted, one to Emanuel, Sweeney & Mahoney on the *addition of strontium sulfate* to the acid zinc sulfate bath when using lead anodes, for the purpose of preventing codeposition of lead,[168] and the other to Diggin & Kardos[169] on a *brightener* for cyanide baths.

Of two items in connection with *silver*, one was a tabulation of silver plating *faults and their correction* by Prince,[170] and the other a patent issued to Kardos[171] on a *brightener* for silver baths comprising the reaction product of a ketone with carbon disulfide and alkali hydroxide.

Very little was noted on other metal deposits during the past year. Laister[172] described processes for deposition of *palladium, platinum and rhodium*, and their applications. Bell[173] detailed the technique involved in deposition of bright, smooth *manganese* deposits, which give cathodic protection to steel. The author employed the sulfate bath, but used hydroxylamine sulfate as a reducing agent instead of SO_2. Little was granted a patent[174] on a *bright antimony bath* and Szekely[175] received one on an alkyl glycol bath for deposition of *germanium*.

Alloys

Although deposition of *tin* did not occupy many authors, tin alloys appeared to be a horse of a different color. Among the noteworthy articles, one by Lowenheim on the *throwing power of tin alloy solutions*,[176] described improvements in the method of Sternfels, which permitted panels to be plated in the regular plating tank instead of in a test cell. The throwing power of *tin-nickel* baths was found to be remarkably high; much higher than ever reported for any straight nickel bath, but no explanation was offered. Also, in connection with tin-nickel, Davies[177] reported progress,

and suggested *modifications in the original bath* based on findings about complexes of tin and fluoride.

Lowenheim, in another article,[178] reviewed practical experience with alloy deposits of *tin with zinc, with nickel and with copper*. This last alloy was also the subject of an extensive investigation by Safranek, Hespenheide & Faust. They reported the protective value of *tin-bronze and speculum* deposits to be greater than copper followed by nickel.[179] Two of these authors, Safranek & Faust[180] also described the production of *bright deposits from a pyrophosphate bath*, using a proprietary brightener, with emphasis on the use of these copper-tin deposits as a replacement for nickel. Completing the list of articles is one by McConnell[181] on the strength of *soldered joints of tin-lead* alloy deposits.

The treatment accorded to *brass deposits* was less slighting than during the previous year. Voyda[182] detailed the formulation and operation of a newly developed *high speed bath*. Plating for *rubber adhesion*, treated extensively about a decade ago but of minor importance in recent years, was the subject of an article by Compton, Ehrhardt & Bittrich.[183] This subject of producing deposits containing 65-75% copper is almost academic from a practical standpoint but the authors' work is extremely interesting in that it demonstrates the possibility of close control over composition without much difficulty. Another process which had its moment on the stage recently, *white brass*, was the subject of a patent granted to Wernlund,[184] covering addition of a *vanadium compound as a brightener*. Another patent was issued to Westbrook & Roehl[185] on a *yellow brass bath* with high caustic content and a copper:zinc ratio of between 35:1 and 10:1.

Other alloys treated in the literature were *zinc-cadmium*, for which Kudryavtsec & Pereturina[186] described the process and the protective value of the deposits. An alloy of 17-20% zinc was found to have protective properties similar to pure cadmium. Finally, Gardam & Tidswell[187] found that the composition of *gold-alloy deposits* could be adjusted, without changing the composition of the plating bath, by applying *pulsed direct current* instead of continuous direct current.

Metallizing - Vacuum and Vapor Processes

Electroforming and metallizing by chemical reduction of aqueous solutions exhibited unexpected activity during the past year. To us, the most interesting article was a discussion of the *design of matrices for successful electroforming*, presented by Lamb & Metzger.[188] Among the patents was the *electroforming of aluminum* using a hydrocarbon bath in which is dissolved an organic additive, and the fusion product of an aluminum halide with a quaternary salt of nitrogen, claimed by Safranek, Schickner & Faust.[189] Other patents were granted to Enslein & Haskins[190] for *printed circuits; electroforming rectifier discs* to Parsons & Perme;[191] a *stripping film* of albumin solution containing borax and an alkylated aromatic sulfanate, to Soby;[192] and production of a *two sided target*, to Teal.[193]

Metallizing non-conductors was covered by two articles and three patents. Silverman & Trego[194] described a process for porcelain and ceramic using *aqueous platinum chloride*, which is dried on and fired in, while Narcus[195] detailed possible methods for producing *conducting films* and industrial applications. The patents consisted of a *conducting coating of silver powder* with a small amount of stearic acid in absolute alcohol, claimed by Perlman;[196] another, a *silver firing paint* disclosed by Gray[197] and the last a method of *plating a plastic steering wheel*, issued to Reindl & Prance.[198]

Vacuum metallizing was treated in only two articles of note, one by Johnson[199] on its application to zinc and aluminum castings, which may be finished to look like *polished chromium* without requiring any polishing operation, and another on the same subject by Seiter.[200] Aside from one patent on a process of coating *polytetrafluoroethylene* films, granted to Croze & Hedrick,[201] which claimed a sintering operation after the metal film is applied, an even dozen patents were issued on *equipment for vacuum metallizing* and improvements in same. Since these would not be considered of general interest, they will not be reviewed here, but readers will find descriptions in the recent issues of METAL FINISHING.

In the field of *gas plating*, in which a volatilized metal salt is decomposed on the surface of the base at high temperature, the inventors were quite busy in 1954. The most unusual process was claimed by Kempe & Ruppender,[202] their improvement consisting of surrounding the article to be coated with a *porous wall*, through which the hydrogen and metal halide vapors were passed. *Metal carbonyls* appeared to be the most commonly used compounds, Lander[203] using carbonyls of molybdenum, tungsten and chromium plus selenium, sulfur or tellurium compounds, to provide a *heat resistant surface;* Fink[204] *applying nickel to aluminum;* Lander[205] coating with *tungsten, chromium and molybdenum;* and Pawlyk[206] employing *chromium hexacarbonyl*. Other patents claimed variations such as reduction of the carbonyl under *vacuum*, issued to Toulmin;[207] use of an *electrostatic field* in the chamber, claimed by Nack;[208] and a unique method of *producing foil*, invented by Davis & Belitz,[209] which consisted of impinging the carbonyl against a heated roll to precipitate the metal, which was then stripped off.

Of the two articles worthy of review, one by Samuel & Lockington[210] described experiments on *deposition from the gas phase* and diffusion of chromium, molybdenum and tungsten into non-ferrous metals, including the properties of the coatings, while the other article[211] reviewed a *commercial process* using carbonyls as the source of the coating metal.

Conversion Films - Corrosion Preventives

In the broad field of *conversion coating*, chromate films shared the spotlight with phosphates last year. In the research department, radiometric studies of the *iron phosphate process* by Eisler & Doss[212] proved the coating to consist of less than 35% ferric phosphate, the balance probably being gamma iron oxide. Other articles consisted of a *review of modern phosphating methods*, in which Drysdale[213] included the zinc, manganese and iron types and their characteristics, and a tabular presentation of hints on good practical *phosphating practice* by Holden.[214] Among the patents, Callahan & Gendernalik[215] disclosed a dihydrogen

phosphate *bath for iron* containing licorice and boric acid; Amundsen & Osip claimed the addition of *alkali fluorides and alkali acid fluorides* as activators;[216] while Bishop[217] suggested a *hydrocarbon acid phosphate salt of an alkylol-containing amine.*

Investigation of *chromate coatings* for zinc and cadmium by Eisler, Doss & Henderson[218] indicated that the sulfate and dichromate in the coatings increase with increase in the sulfuric acid content of the dip but not proportionately. The corrosion resistance of films from the *chromic-nitric* solutions was found to be no better than those from the *chromic-sulfuric* baths. Bubsey[219] indicated that chromate films on *hot galvanized steel* lower the corrosion rate in brine and reduce the formation of white corrosion products, while Pocock[220] surveyed chromate treatments of various metals for *protective purposes.* The patents consisted of a *sodium silicate-chromate process* for preventing white rust on zinc, claimed by Neish,[221] and a *single package treatment* consisting of zinc chromate, a resin and solvent and *a phosphate to be used on iron, zinc and aluminum,* disclosed by Bell.[222] Spruance & Newhard[223] claimed an acid solution containing fluorides, dichromates, arsenate or phosphate, and chloride or sulfate in specified amounts. For those interested in the broad field of *conversion coatings on aluminum,* Wernick & Pinner[224] are suggested for a complete *survey of the theory and practice.*

Other corrosion preventive patents were culled from the patent disclosures. Rohrback, McCloud & Scott[225] claimed a *pelleted corrosion inhibitor* consisting of sodium arsenite and arsenous oxide or metallic zinc. Burns[226] applied a solution of alkaline silicate and finely divided zinc, then treated with a saline solution to produce a *complex zinc-alkali-silicate* in situ. For the *tarnish prevention of silver,* Matthews & Sawyer claimed an aqueous fluoborate solution containing a metal more electropositive than silver.[227] *Volatile inhibitors* included vapors of benzoic and similar acids in company with water vapors, disclosed by Shnitzler.[228] This type of inhibitor was also described in an article by Baker,[229] who suggested methods of *preparation, evaluation and test procedures.*

Hydrocarbon or organic protective coatings were the subject of numerous patents,[285] which are listed in the bibliography.

Testing and Control

The *determination of boric acid* in nickel plating solutions, the procedure for which leaves much to be desired even though the accuracy is probably sufficient for most purposes, was investigated by Verma & Agrawal,[229a] who offered methods in which the nickel color is removed with *potassium oxalate* and methods suitable in the presence of nickel and ammonium salts, using either a single or double titration. Gabrielson[230] suggested the employment of a *cation exchanger to remove the nickel ions,* which mask the titration end point.

Polarigraphic methods for nickel, chloride and boric acid in nickel plating solutions were described by Petrocelli & Tatoian,[231] and a stable reagent to replace standard sodium cyanide was offered by Langford.[232] *Disodium ethylenediamine tetra-acetate* is suitable for nickel determinations but magnesium interferes. Leftin[233] also employed this reagent for *direct titration of zinc and cadmium,* finding the method to be rapid and accurate. In an article on determination of *free cyanide and zinc* in zinc cyanide baths, Muraca[234] defined free cyanide as the activity of cyanide ion at operating conditions.

The increased application of electroless nickel has emphasized the need for a good method of determining *hypophosphite,* especially in the presence of phosphite. Bernhart[235] suggested the use of sulfatoceric acid and ferroin indicator, while Gutzeit[236] disclosed a colorimetric method using molybdate.

Analysis of wastes unearthed some interesting developments, among which Falkof, Witten & Gehauf[237] developed a method for *detection of cyanide,* as did Ludzack, Moore & Ruchhoft,[238] whose procedure was claimed suitable for both high concentrations and traces of a few parts per billion. *Colorimetric* methods were offered for copper,[239] iron,[240] and zinc[241] by Gardner, Muraca & Serfass. Numerous testing methods were described in the literature, one of the most noteworthy being an electrochemical one by Pierce & Pinner[242] for rapidly *evaluating plated coatings* to yield quantitative data in number of holes, and qualitative data concerning roughness, inclusions, and erratic plate thickness. Harris reviewed *cleanliness tests;*[243] Kinney & Festa[244] used models for studying *electric fields* which determine relative current density; Neish[245] measured the susceptibility of galvanized surfaces to *humid storage stain,* using a rapid steam test and a water film test; and Linford & Feder detailed the construction of equipment for study of results of *electroplating on oxide-soiled basis metals.*[246]

Platers, who use the *B.N.F. jet test* for organic-brightened nickel deposits, are warned by Edwards[247] that the rate of penetration varies with the type of brightener and the deposit thickness, so that each process requires calibration. The author suggests this test should be used as a "limit" type rather than an absolute test. Hammond[248] described the *origin of internal stress* in deposits and methods for its determination, while Kushner[249] detailed a new *simplified and accurate instrument* for the purpose. Other testing devices described in the literature included three new *electronic thickness gauges* for metallic coatings[250] and an *accelerated corrosion device* consisting, according to Coburn,[251] of a heating and humidifying system, a corrosion chest and a dipping mechanism.

Miscellaneous

An important research was reported upon by Ogburn & Benderly[252] on the nature, cause and effect of *porosity in electrodeposits,* in which they pointed out the fact that measurement of initial porosity of a detached foil has serious limitations. Thon & Dean[253] reported on their study of *gas permeability constant* in porous deposits with pressure difference. Leonard[254] described the use of *chelating agents* in electroplating, with a brief account of the chemistry of the process and some of its applications, while *ion-exchange* was the subject of articles by Kressman[255] and by Keating.[256]

Two interesting presentations on *specifications* were

offered last year. One by Promisel & Promisel[257] summarized all the pertinent *government specifications* on finishes, the other, by Phillips,[258] described the development of plating in the *automotive field* and the evolution of specifications therefor. *Plastic materials of construction* were treated by Jaray[259] and by Thomas,[260] who described the use of *unplasticized polyvinyl chloride* in plating plants, presenting a table showing the chemical resistance of the material to various chemicals. Walter[261, 262] outlined thermostatic *temperature control* methods for finishing processes.

Rectifiers were covered in an article by Richards[263] in which data were presented on *voltage and current fluctuations* in the output of selenium stacks. *Periodic reverse* was the subject of two patents, to Jernstedt & Patrick[264] on the use of the process for reducing roughness and maintaining uniform deposit thickness, and to Gray & Murray[265] on *a wire plating process* in which the current reversal was performed in separate cells as the wire advanced. Also, on *continuous wire plating*, Kenmore & Manson[266] disclosed a method in which heavy wire is rolled into a spiral coil which is then moved through the various processing tanks.

The bothersome problem of *plating powder metal compacts* was treated by Rushbrook[267] in connection with avoiding entrapping solutions in the pores, and by Hausner & Michaelson[268] who pointed out that, if the density is more than 95% of theoretical, the compact can be treated like massive metal but, if the density is 85-95%, surface voids should be closed by some type of impregnation. On the other hand, Faust & Safranek[269] described a method of producing *coherent porous deposits*, of at least 50% porosity, in copper, nickel, and zinc by use of colloidal graphite as an addition agent.

Other items of general interest included an article on counterflow *rinse tank design* by Mohler[270] and patents on a method of *plating irregularly shaped objects* issued to Beaver[271] and on the production of *bright, corrosion resistant deposits* by nickel plating at least 0.00005" nickel, followed by at least 0.000005" zinc, then buffing to cause the zinc to penetrate the pores. The inventors, Hammond & Bowman,[272] finally chromium plated the surface.

Colored finishes were covered in patents issued to Deniston[273] for a *black oxide on aluminum* by immersion in an acid solution containing oxidizing agents and other materials, and to Singler[274] for a *black electrolytic finish* for metals using a solution of nickel chloride, zinc chloride, sodium chloride and ammonium molybdate. A *matte finish on copper alloys* using a solution of ammonium persulfate and hydrogen peroxide was disclosed by Burnside[275] and a method for *stripping various metals* from iron by immersion in molten magnesium was claimed by Lohberg.[276]

Equipment patents will serve to close this review. Beebe[277] patented a *rack for concave surfaces*, Bart[278] disclosed an apparatus for *plating the interior of pipe*, Davis[279] claimed a *work transfer device* for a conveyor, and Hassell[280] an apparatus for *reduction of heavy edge coating in strip plating*. Other equipment included a *continuous wire plating machine*, patented by DeWitz & Roy,[281] a rigid tubular *core for filtering elements*, claimed by Lowe,[282] a *combination filter and agitator* for plating solutions, on which a patent was granted to Cady & Sabatka[283] and an *automatic type dryer* using vibrating trays for bulk work, covered by Kirkpatrick.[284]

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18. J. L. Fisher. U. S. Pat. 2,677,381 (May 4).
19. T. J. Hutchinson, Jr. U. S. Pat. 2,670,281 (Feb. 23).
20. W. I. Gladfelter. U. S. Pat. 2,682,135 (June 29).
21. R. R. Berg. U. S. Pat. 2,667,015 (Jan. 26).
22. E. R. Ljungdell & K. G. Krantz. U. S. Pat. 2,696,910 (Dec. 14).
23. P. H. Cardwell. J. Electrochem. Soc., **101**, 84.
24. J. H. Peterson, G. M. Nichols & W. F. McDevit. Metal Fin., **52**, 62 (Oct.).
25. P. K. Dubin & F. A. Locke. Iron Age, **174**, 62 (Dec. 23).
26. E. E. Vonada. U. S. Pat. 2,673,836 (Mar. 30).
27. E. D. Martin. U. S. Pat. 2,668,130 (Feb. 2).
28. R. R. Barnes. U. S. Pat. 2,697,050 (Dec. 14).
29. E. C. McHenry. U. S. Pat. 2,676,599 (Apr. 27).
30. R. Dunlevy, H. Frick & J. H. Shoemaker. U. S. Pat. 2,674,250-1 (Apr. 6). 2,674,550-1 (Apr. 6).
31. J. H. Noble, R. Pottberg & U. C. Tainton. U. S. Pat. 2,678,289-90 (May 11).
32. H. R. Spence, A. N. Johnson & S. G. Osborne. U. S. Pat. 2,676,900 (Apr. 27).
33. N. H. Brundin. U. S. Pat. 2,694,657 (Nov. 16).
34. A. E. Chester & J. T. Irwin. U. S. Pat. 2,692,187-8 (Oct. 19).
35. S. Mellgren & O. W. Moles. U. S. Pat. 2,697,051 (Dec. 14).
36. H. B. Bomberger, M. B. Vordahl & W. L. Finlay. Mater. & Meth., **40**, 105 (Dec.).
37. L. McDonald & A. E. Hawley. U. S. Pat. 2,674,523 (Apr. 6).
38. L. F. Spencer. Metal Fin., **52**, 54 (Feb.).
39. H. Faint & R. S. Modjeska. Plating, **41**, 1422.
40. G. J. Kahan, W. W. Macchia & J. M. Fairbank. Plating, **41**, 649.
41. J. E. Taylor. Iron Age, **173**, 108 (Jan. 21).
42. S. Wernick & R. Pinner. Metal Fin., **52**, 88 (June).
43. W. G. Balz & C. H. Castle. U. S. Pat. 2,684,562 (July 27).
44. P. K. Cuppers. U. S. Pat. 2,664,676 (Jan. 5).
45. P. J. More. U. S. Pat. 2,665,439 (Jan. 12)
46. R. Jaron. U. S. Pat. 2,667,017 (Jan. 26).
47. R. V. Twyning. Plating, **41**, 1296.
48. W. C. Burt. U. S. Pat. 2,677,219 (May 4).
49. C. B. Young. U. S. Pat. 2,681,274 (June 15).
50. E. A. Fiser. U. S. Pat. 2,687,357 (Aug. 24).
51. W. W. Coffeen. U. S. Pat. 2,694,004 (Nov. 9).
52. R. E. Busch & E. L. Kurtzwarth. U. S. Pat. 2,668,398 (Feb. 9).

53. G. R. Churchill. U. S. Pat. 2,687,602 (Aug. 31).
54. P. E. Hawkinson. U. S. Pat. 2,673,389 (Mar. 30).
55. R. O. Peterson. Mater. & Meth., **40**, 96 (Aug.).
56. R. O. Peterson. U. S. Pat. 2,666,282 (Jan. 19).
57. R. O. Peterson. U. S. Pat. 2,682,734 (July 6).
58. B. E. Nelson & R. O. Peterson. U. S. Pat. 2,682,065 (June 29).
59. A. S. McGibbon. U. S. Pat. 2,694,274 (Nov. 16).
60. S. L. Johnson. Finish, **11**, 32 (Dec.).
61. O. S. Buckner. U. S. Pat. 2,682,733 (July 6).
62. G. Walters. U. S. Pat. 2,672,715 (Mar. 23).
63. G. E. McGuire. U. S. Pat. 2,677,922 (May 11).
64. H. D. Coe, Jr. & J. B. Dym. U. S. Pat. Reiss. 23,846 (July 6).
65. R. G. Riedesel, T. J. Miller & L. A. Martin. U. S. Pat. 2,666,280 (Jan. 19).
66. C. Wagner. J. Electrochem. Soc., **101**, 225.
67. A. T. Steer. Electropl., **7**, 249.
68. R. Pinner. Electropl., **7**, 295.
69. M. W. Riley. Mater. & Meth., **39**, 104 (June).
70. A. Korbelak & C. M. Rively. Plating, **41**, 1446.
71. J. F. Jumer. U. S. Pat. 2,665,247 (Jan. 5).
72. S. Tajima & T. Mori. Prod. Fin., **19**, 26 (Oct.).
73. R. H. Espy. U. S. Pat. 2,695,872 (Nov. 30).
74. T. S. Gamble. U. S. Pat. 2,692,853 (Oct. 26).
75. F. H. Hesch. U. S. Pat. 2,682,502-3 (June 29).
76. E. M. Prosen. U. S. Pat. 2,674,571 (Apr. 6).
77. H. G. McLeod & C. J. Wernlund. U. S. Pat. 2,694,678 (Nov. 16).
78. E. R. duFresne & J. R. Swihart. U. S. Pat. 2,673,143 (Mar. 23).
79. J. T. Ferguson. U. S. Pat. 2,671,717 (Mar. 9).
80. L. McDonald. U. S. Pat. 2,687,346 (Aug. 24).
81. R. C. Spooner. U. S. Pat. 2,678,875 (May. 18).
82. Bo-Shin Ro. U. S. Pat. 2,692,189 (Oct. 19).
83. S. C. Hayes & J. T. Lomakin. U. S. Pat. 2,694,001 (Nov. 9).
84. A. C. Simon. U. S. Pat. 2,689,785 (Sept. 21).
85. L. P. Fox. U. S. Pat. 2,680,678 (June 8).
86. R. M. Wick. U. S. Pat. 2,683,687 (July 13).
87. R. Pinner. Electropl., **7**, 127.
88. F. LaMonica. U. S. Pat. 2,664,675 (Jan. 5).
89. C. R. Gillette & W. P. Burroughs. U. S. Pat. 2,683,343 (July 13).
90. M. M. Maynes. Plating, **41**, 55.
91. A. S. Kohler. Plating, **41**, 1013.
92. H. L. Beaver. Prod. Fin., **18**, 24 (Jan.).
93. H. Chase. Metal Fin., **52**, 65 (Oct.).
94. E. E. Halls. Prod. Fin. (Br.), **7**, 72 (Apr.).
95. E. E. Halls, Prod. Fin. (Br.), **7**, 61 (Feb.).
96. L. E. Colclesser. U. S. Pat. 2,673,076 (Mar. 23).
97. S. E. Barr & C. I. Knecht. U. S. Pat. 2,697,689 (Dec. 21).
98. R. B. Mason & P. E. Fowle. J. Electrochem. Soc., **101**, 53.
99. M. S. Hunter & P. Fowle. J. Electrochem. Soc., **101**, 481.
100. M. S. Hunter & P. Fowle. J. Electrochem. Soc., **101**, 514.
101. A. W. Brace. Electropl., **7**, 329, 376.
102. A. E. Bratt. Bull. Inst. Metal Fin., **4**, No. 1, 63.
103. R. J. Brink, Sewage & Ind. Wastes, **26**, 197 (Feb.).
104. C. F. Burrows. U. S. Pat. 2,692,851-2 (Oct. 26).
105. G. W. Young & J. L. Hain. U. S. Pat. 2,665,243 (Jan. 5).
106. G. G. Gauthier. U. S. Pat. 2,685,563 (Aug. 3).
107. O. Schaaber. U. S. Pat. 2,666,023 (Jan. 12).
108. W. H. Wood. U. S. Pat. 2,681,310 (June 15).
109. S. R. Prance & H. J. Reindl. U. S. Pat. 2,683,113 (July 6).
110. R. E. Johnson. U. S. Pat. 2,691,627 (Oct. 12).
111. W. G. Zelley. U. S. Pat. 2,676,916 (Apr. 27).
112. A. W. Castle. Electropl., **7**, 291.
113. R. C. Spooner & D. P. Seraphim. Trans. Inst. Metal Fin., **31**, No. 3.
114. A. Brenner. Metal Fin., **52**, 68 (Nov.), 61 (Dec.).
115. J. D. Maclean & S. M. Karten. Plating, **41**, 1284.
116. H. J. West, Metal Fin., **52**, 64 (Mar.).
117. H. J. West. Metal Fin., **52**, 72 (July).
118. A. E. Durkin. Iron Age, **174**, 91 (July 8).
119. G. Gutzeit. Metal Prog., **66**, 113 (July 1).
120. G. Gutzeit & R. W. Landon. Plating, **41**, 1416.
121. G. Gutzeit. U. S. Pat. 2,694,019 (Nov. 9).
122. R. R. Reschan & A. Krieg. U. S. Pat. 2,694,017 (Nov. 9).
123. G. Gutzeit, W. J. Crehan & A. Krieg. U. S. Pat. 2,690,401 (Sept. 28).
124. W. J. Crehan. U. S. Pat. 2,690,402 (Sept. 28).
125. G. Gutzeit, W. J. Crehan & A. Krieg. U. S. Pat. 2,690,403 (Sept. 28).
126. D. T. Ewing, J. K. Werner, C. J. Owen, W. O. Dow & R. J. Rowe. Plating, **41**, 1307.
127. L. H. Curkin & R. W. Moeller. Plating, **41**, 1154.
128. T. E. Such. Trans. Inst. Met. Fin., **31**, advance copy 13.
129. W. A. Wesley & B. B. Knapp. Trans. Inst. Met. Fin., **31**, advance copy 18.
130. O. A. Stocker, A. Korbelak & S. A. Carrano. Plating, **41**, 491.
131. M. B. Diggin. Trans. Inst. Met. Fin., **31**, advance copy 16.
132. M. B. Diggin, Metal Prog., **66**, 132 (Oct.).
133. R. C. Barrett. Plating, **41**, 1027.
134. R. B. Saltonstall. Trans. Inst. Met. Fin., **31**, advance copy 15.
135. H. Leidheiser. Trans. Inst. Met. Fin., **31**, advance copy 14.
136. H. Brown, U. S. Pat. 2,678,910 (May 18).
137. H. Brown. U. S. Pat. 2,690,996 (Oct. 5).
138. H. Brown. U. S. Pat. 2,694,041 (Nov. 9).
139. F. Passal. U. S. Pat. 2,684,327 (July 20).
140. A. H. DuRose & K. S. Willson. U. S. Pat. 2,683,115 (July 6).
141. R. L. Sass & S. L. Eisler. Plating, **41**, 497.
142. L. J. Frolen. Chemistry, **27**, 34-9 (Jan.).
143. J. E. Starack, E. J. Seyb & A. C. Tulumello. Plating, **41**, 1171.
144. C. P. Brittain & G. C. Smith. Trans. Inst. Met. Fin., **31**, advance copy 10.
145. C. Williams & R. A. Hammond. Trans. Inst. Met. Fin., **31**, advance copy 9.
146. C. A. Snavely, C. L. Faust & J. E. Bride. U. S. Pat. 2,693,444 (Nov. 2).
147. J. E. Stareck & R. Dow. U. S. Pat. 2,686,756 (Aug. 17).
148. L. G. DeQuasie & R. E. Kochs. U. S. Pat. 2,666,029 (Jan. 12).
149. C. F. Geese. U. S. Pat. 2,684,939 (July 27).
150. W. R. Wolfe, H. Chessin, E. Yeager & F. Hovorka. J. Electrochem. Soc., **101**, 590.
151. B. D. Ostrow & F. I. Nobel. Plating, **41**, 885.
152. F. I. Nobel & B. D. Ostrow. Plating, **41**, 892.
153. C. W. Roberts. Metallurgia, **50**, 207 (Nov.).
154. G. Gabrielson. Metal Fin., **52**, 60 (Feb.).
155. H. Prince. Prod. Fin. (Br.), **7**, 54 (Aug.).
156. R. P. Nevers, R. L. Hungerford & E. W. Palmer. Plating, **41**, 1301.
157. R. P. Nevers & E. W. Palmer. U. S. Pat. 2,689,216 (Sept. 14).
158. G. E. Murray, U. S. Pat. 2,667,453 (Jan. 26).
159. G. Norwitz. U. S. Pat. 2,680,711 (June 8).
160. D. M. Overcash & R. B. Parks. U. S. Pat. 2,696,467 (Dec. 7).
161. B. D. Ostrow. U. S. Pat. 2,694,677 (Nov. 16).
162. G. W. Jernstedt. U. S. Pat. 2,690,997 (Oct. 5).
163. A. E. Chester & J. T. Irwin. U. S. Pat. 2,677,653-4 (May 4).
164. R. E. Howell. U. S. Pat. 2,677,652 (May 4).
165. R. Mills & C. J. Thwaites. Sheet Met. Ind., **31**, 733.
166. C. F. Gurnham. Prod. Fin., **18**, 74 (June).
167. D. E. Weimer & J. W. Price. Trans. Inst. Met. Fin., **30**.
168. W. A. Emanuel. K. O. Sweeney & J. F. Mahoney. U. S. Pat. 2,673,180 (Mar. 23).
169. M. B. Diggin & O. Kardon. U. S. Pat. 2,680,712 (June 8).
170. H. Prince. Prod. Fin. (Br.), **7**, 69 (Oct.).
171. O. Kardos. U. S. Pat. 2,666,738 (Jan. 19).
172. E. H. Laister. Metal Ind., **85**, 427.
173. W. A. Bell. Trans. Inst. Met. Fin., **31**, advance copy 27.
174. J. D. Little. U. S. Pat. 2,683,114 (July 6).
175. G. Szekely. U. S. Pat. 2,690,422 (Sept. 28).
176. F. A. Lowenheim. Plating, **41**, 1440.
177. A. E. Davies. Trans. Inst. Met. Fin., **31**, advance copy 24.
178. F. A. Lowenheim. Trans. Inst. Met. Fin., **31**, advance copy 23
179. W. H. Safranek, W. G. Hespenheide & C. L. Faust. Metal Fin., **52**, 70 (Apr.).
180. W. H. Safranek & C. L. Faust. Plating, **41**, 1159.

181. V. P. McConnell. Plating, **41**, 636.
182. T. Z. Voyda. Metal Fin., **52**, 56 (Dec.).
183. K. G. Compton, R. A. Ehrhardt & G. Bittrich. Plating, **41**, 1431.
184. C. J. Wernlund. U. S. Pat. 2,668,795 (Feb. 9).
185. L. R. Westbrook & E. J. Roehl. U. S. Pat. 2,684,937 (July 27).
186. N. I. Kudryavtsev & E. T. Pereturina. Electropl., **7**, 372.
187. G. E. Gardam & N. E. Tidswell. Trans. Inst. Met. Fin., **31**, advance copy 25.
188. V. A. Lamb & W. H. Metzger, Jr., Tool Eng., **33**, 55 (Aug.).
189. W. H. Safranek, W. C. Schickner & C. L. Faust. U. S. Pat. 2,692,850 (Oct. 26).
190. K. Enslein & F. J. Haskins. U. S. Pat. 2,666,008 (Jan. 12).
191. C. H. Parsons & R. J. Perme. U. S. Pat. 2,691,144 (Oct. 5).
192. W. Soby. U. S. Pat. 2,689,214 (Sept. 14).
193. G. K. Teal. U. S. Pat. 2,682,501 (June 29).
194. L. Silverman & K. Trego. Metal Fin., **52**, 69 (Apr.).
195. H. Narcus. Plating, **41**, 901.
196. D. Perlman. U. S. Pat. 2,683,670 (July 13).
197. R. B. Gray. U. S. Pat. 2,695,275 (Nov. 23).
198. H. J. Reindl & S. R. Prance. U. S. Pat. 2,683,112 (July 6).
199. R. O. Johnson. Precis. Met. Molding, **12**, 54 (Feb.).
200. J. G. Seiter. Prod. Fin., **18**, 38 (May).
201. M. W. Croze & P. L. Hedrick. U. S. Pat. 2,689,805 (Sept. 21).
202. R. A. Kempe & R. W. Ruppender. U. S. Pat. 2,689,807 (Sept. 21).
203. J. J. Lander. U. S. Pat. 2,671,739 (Mar. 9).
204. A. O. Fink. U. S. Pat. 2,682,702 (July 6).
205. J. J. Lander. U. S. Pat. 2,690,980 (Oct. 5).
206. P. Pawlyk. U. S. Pat. 2,685,532 (Aug. 3).
207. H. A. Toulmin. U. S. Pat. 2,685,124 (Aug. 3).
208. H. Nack. U. S. Pat. 2,685,535 (Aug. 3).
209. O. F. Davis & H. G. Belitz. U. S. Pat. 2,685,121 (Aug. 3).
210. R. L. Samuel & N. A. Lockington. Trans. Inst. Met. Fin., **31**, advance copy 11.
211. Anon. Electropl., **7**, 16.
212. S. L. Eisler & J. Doss. Metal Fin., **52**, 60 (Mar.).
213. R. F. Drysdale. Trans. Inst. Met. Fin., **30**.
214. H. A. Holden. Electropl., **7**, 416.
215. W. A. Callahan & F. L. Gendernalik. U. S. Pat. 2,674,552 (Apr. 6).
216. P. L. Amundsen & W. A. Osip. U. S. Pat. 2,665,231 (Jan. 5).
217. J. W. Bishop. U. S. Pat. 2,665,995 (Jan. 12).
218. S. L. Eisler, J. Doss & M. A. Henderson. Plating, **41**, 147.
219. F. J. Bubsey. Metal Prog., **65**, 122 (May).
220. W. E. Pocock. Metal Fin., **52**, 48 (Dec.).
221. R. A. Neish. U. S. Pat. 2,665,232 (Jan. 5).
222. E. P. Bell. U. S. Pat. 2,692,840 (Oct. 26).
223. F. P. Spruance, Jr. & N. J. Newhard, Jr. U. S. Pat. 2,678,291 (May 11).
224. S. Wernick & R. Pinner. Metal Fin., **52**, 68 (Oct.), 83 (Nov.).
225. G. H. Rohrback, D. M. McCloud & W. R. Scott. U. S. Pat. 2,684,332-3 (July 20).
226. A. E. Burns, Jr. U. S. Pat. 2,673,817 (Mar. 30).
227. C. F. Matthews & J. C. Sawyer. U. S. Pat. 2,684,328 (July 20).
228. M. J. Shnitzler. U. S. Pat. 2,674,553 (Apr. 6).
229. H. R. Baker. I. E. Chem., **46**, 2593.
229a. M. R. Verma & K. C. Agrawal. Electropl., **7**, 171, 403.
230. G. Gabrielson. Plating, **41**, 47.
231. J. V. Petrocelli & G. Tatoian. Plating, **41**, 262.
232. K. E. Langford. Electropl., **7**, 46.
233. J. P. Leftin. Metal Fin., **52**, 74 (Apr.)
234. R. F. Muraca. Plating, **41**, 1018.
235. D. N. Bernhart. Anal. Chem., **26**, 1798.
236. G. Gutzeit. U. S. Pat. 2,697,651 (Dec. 21).
237. M. M. Falkof, B. Witten & B. Gehauf. U. S. Pat. 2,678,260 (May 11).
238. F. J. Ludzack, W. A. Moore & C. C. Ruchhoft. Anal. Chem., **26**, 1784.
239. D. G. Gardner, R. F. Muraca & E. J. Serfass. Plating, **41**, 487.
240. E. J. Serfass, R. F. Muraca & D. G. Garner. Plating, **41**, 632.
241. R. F. Muraca, D. G. Gardner & E. J. Serfass. Plating, **41**, 155.
242. W. J. Pierce & W. L. Pinner. Plating, **41**, 1034.
243. J. C. Harris. Prod. Fin., **18**, 32 (Aug.).
244. G. F. Kinney & J. V. Festa. Plating, **41**, 380.
245. R. A. Neish. Corrosion, **10**, 440.
246. H. B. Linford & D. O. Feder. Plating, **41**, 1183.
247. J. Edwards. Bull. Inst. Met. Fin., **4**, No. 1, 33.
248. R. A. Hammond. Trans. Inst. Met. Fin., **30**.
249. J. B. Kushner. Plating, **41**, 1146.
250. Anon. Metal Fin., **52**, 52 (Oct.).
251. S. K. Coburn. Corrosion, **10**, 181.
252. F. Ogburn & A. Benderly. Plating, **41**, 61, 169.
253. N. Thon & D. Dean. Plating, **41**, 503.
254. C. D. Leonard. Electropl., **7**, 365.
255. R. R. Kressman. Trans. Inst. Met. Fin., **30**.
256. R. J. Keating. Metal. Fin., **52**, 52 (Dec.).
257. N. E. Promisel & D. M. Promisel. Metal Fin., **52**, 61 (May), 95 (June), 72 (Aug.).
258. W. M. Phillips. Metal Fin., **52**, 60 (July), 73 (Aug.), 76 (Sept.).
259. F. F. Jaray. Prod. Fin. (Br.), **7**, 62 (May), 88 (June), 81 (Aug.).
260. L. N. Thomas. Plating, **41**, 269.
261. L. Walter. Electropl., **7**, 212.
262. L. Walter. Met. Ind., **85**, 307, 329, 353, 373.
263. V. L. Richards. Plating, **41**, 773.
264. G. W. Jernstedt & J. D. Patrick. U. S. Pat. 2,678,909 (May 18).
265. A. N. Gray & G. E. Murray. U. S. Pat. 2,686,859 (Aug. 17).
266. H. Kenmore & W. J. Manson. U. S. Pat. 2,680,710 (June 8).
267. R. Rushbrook. Electropl., **7**, 92.
268. H. H. Hausner & H. B. Michaelson. Iron Age, **174**, 88 (Sept. 30).
269. C. L. Faust & W. H. Safranek. Trans. Inst. Met. Fin., **31**, advance copy 31.
270. J. B. Mohler. Metal Fin., **52**, 56 (Oct.).
271. J. F. Beaver, Jr. U. S. Pat. 2,696,466 (Dec. 7).
272. M. B. Hammond & G. B. Bowman. U. S. Pat. 2,676,917 (Apr. 27).
273. G. L. Deniston. U. S. Pat. 2,681,873 (June 22).
274. J. C. Singler. U. S. Pat. 2,679,475 (May 25).
275. D. G. Burnside. U. S. Pat. 2,678,876 (May 18).
276. K. Lohberg. U. S. Pat. 2,683,085 (July 6).
277. A. H. Beebe, Jr. U. S. Pat. 2,697,690 (Dec. 21).
278. S. G. Bart. U. S. Pat. 2,689,215 (Sept. 14).
279. J. V. Davis. U. S. Pat. 2,681,015 (June 15).
280. E. J. Hassell. U. S. Pat. 2,690,424 (Sept. 28).
281. A. E. DeWitz & F. P. Roy. U. S. Pat. 2,695,269 (Nov. 23).
282. R. P. Lowe. U. S. Pat. 2,677,466 (May 4).
283. S. S. Cady & W. E. Sabatka. U. S. Pat. 2,667,270 (Jan. 26).
284. A. H. Kirkpatrick. U. S. Pat. 2,666,995 (Jan. 26).
285. 2,666,745; 2,667,408; 2,671,736; 2,672,444; 2,673,161; 2,677,618; 2,680,094; 2,680,718; 2,687,376; 2,687,965; 2,695,848.

Plating Wastes — A Review of Research*

By Dr. D. Gardner Foulke** & Raymond F. Ledford***

Introduction

At the 1954 meeting of the National Technical Committee on Industrial Wastes it was reported that there were 405 research projects currently under way on waste problems.[1] This very considerable amount of research, and the report was by no means complete, testifies to the effort being devoted to the problem of stream pollution abatement. Although most of the research just referred to was carried out in fields other than electroplating, there has been considerable activity with respect to plating and metal finishing wastes in recent years.

In order to effect a breakdown of plating waste research, the subject has been divided into two divisions, academic and applied. This is admittedly a very arbitrary classification and will refer more to where the work is being done or was done than to theoretical vs. practical research. The work done at educational institutions has been essentially applied in most cases, the only real difference is that the practical research section will cover "in plant" or engineering data assembled for plant design.

It might well be pointed out at the start that present trends in the field of electroplating and metal finishing are:

1. Reduction of the quantity of waste
2. Conservation of water

This does not mean that earlier established methods of destroying wastes are not being adopted and equipment installed. Equipment of this type will be required particularly where toxic wastes are being treated. Rather, the trends point up (1) the advantages of good housekeeping and engineering practices and (2) the growing importance of water conservation in our industrial economy.

The reduction of the quantity of wastes has been effected by the use of reclaim rinses, the elevation of conveyor arms for a number of stations at the end of the plating tank to permit drippage into the plating tank, the use of ion exchange systems and other purification means to eliminate need for periodic dumping (anodizing and pickling) and, finally, by enlisting the aid of the design engineer to provide drainage of the part and thus minimize drag-out.

The conservation of water has been accomplished by the use of spray or fog rinses, the use of ion-exchange or chemical treatment (e.g. cyanide destruction) in conjunction with rinses, the injection of air into rinses to make for better rinsing with less water, and the use of valve locking devices to limit the amount of rinse water to as much as shown by study to be sufficient.

Two groups have been particularly active with respect to metal finishing waste treatment research, the *American Electroplaters' Society* and the *Ohio River Valley Water Sanitation Commission*. In addition, a great amount of work has been done by individual companies in their laboratories or those of consultants in an effort to solve particular problems, much of which is unpublished and unavailable. Recently, a number of suppliers to the metal finishing industry have interested themselves in waste treatment equipment and have set up research projects concerned both with processes and equipment.

Academic Research

CYANIDES:

Considerable research work has been sponsored by the AES which set up a project (No. 10) on Disposal of Plating Room Wastes in 1947. Project No. 2, established to develop analytical procedures for plating constituents, also cooperated by studying methods for the determination of constituents in plating wastes.

The major activity of Project No. 10, under *Dr. B. F. Dodge* at Yale University, has been that of cyanide waste disposal. A critical review of the literature[2] of cyanide waste disposal covers rather completely the research in this field to 1949 and, since this is available, it is felt that any reference to work prior to this time is unnecessary. Investigations carried out under this program included treatment with hypochlorites and destruction of cyanates, batch volatilization of hydrogen cyanide from aqueous solutions, ion exchange treatment of cyanide wastes and ozone treatment of cyanide wastes. It was concluded that cyanides can be oxidized completely to cyanates by hypochlorites in less than five minutes at room temperature and that cyanates can be destroyed by hypochlorite oxidation for one hour. The first step should be carried out above a pH of 10 to hold the production of cyanogen chloride to a low value and the second reaction should be done

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*Based on a paper presented at the Ninth Industrial Waste Conference May 12, 1954 at Purdue University.

**Hanson-Van Winkle-Munning Co.
***Industrial Filter & Pump Mfg. Co.

at a pH of 7.5 to 9 or lower.[3] The second report[3] included a formula describing the effect of variables on the rate of volatilization of HCN. This approach to the treatment of cyanide wastes has been employed by several plants and was reported by *T. Fadgen* at the 2nd Purdue Industrial Waste Conference.

The ion exchange method of removing cyanide was not thoroughly studied, but it was found that the dual system was more satisfactory than the single anion exchange treatment.[4] Considerable research has been carried out since this report by supply companies and this will be covered later in this paper.

The study of ozone oxidation of cyanides carried out at Yale for the AES showed that the reaction was rapid, but did not appear to proceed beyond the cyanate stage, and that oxidation catalysts such as copper or manganese should be present to prevent excessive loss of unreacted ozone. Neither ferrocyanides or ferricyanides are decomposed by ozone. Tyler et al.[5] have reported the use of 1.84 lb. ozone to oxidize one lb. of cyanide(mol to mol) for cadmium cyanide baths, that oxidation beyond the cyanate stage was inefficient and a pH of 10-12 favored a more efficient reaction. The study of mechanism of the ozonation of cyanide is presently under way at Syracuse University, supported by the Welsbach Corp. This work is as yet incomplete, but *Dr. C. S. Grove, Jr.* reports[6] that work done to date indicates the reactions postulated by Tyler and associates[5] are true.

$$2\,KCN + 2O_3 \rightarrow 2\,KCNO + 2O_2$$
$$2\,KCNO + H_2O + 3O_3 \rightarrow 2\,KHCO_3 + N_2 + 3O_2$$
$$2\,KCN + H_2O + 5O_3 \rightarrow 2\,KHCO_3 + N_2 + 5O_2$$

It also appears that ozone demand increases as lower cyanide concentrations are reached and that some cyanate is destroyed by ozone. In the presence of cupric ion, 100 ppm of cyanide is reduced to 25 ppm residual, with 145 ppm O_3 (95% of which is absorbed) and 76.7 ppm cyanate as cyanide. With 317 ppm O_3 applied (76.1% adsorbed) no residual cyanide is found and only 24.5 ppm of cyanate, calculated to cyanide is found in the residue.

An interesting summary of the engineering and economic aspects of the disposal of cyanide wastes by Dr. Dodge was presented at the 1952 Convention of the AES. Thirteen methods of treatment for cyanide wastes were studied[7] from the economic standpoint, seven being ruled out immediately and one after some consideration. Flow sheets for treatment with hypochlorites, ozone, electrolytic oxidation, batch acidifications, and ion exchange were presented and tentative cost factors were presented to indicate hypochlorite treatment to be attractive.

Project No. 10 has been inactive for some time because of lack of graduate students, a problem not uncommon in educational institutions today. It should be added, however, that Dr. Dodge has recently been engaged in designing a treatment plant for silver wastes which was described in a paper presented at the 41st annual convention of the AES.

For a number of years the plating waste problem has been under study at Purdue University by Professor Bloodgood and his students.[8] A thesis is now in preparation by *William J. Bregley, Jr.* dealing with the treatment of cyanide solutions with various organic and inorganic compounds including formaldehyde, acetaldehyde, acetone, ferrous sulfate and ferrous ammonium sulfate. Acetaldehyde was found to be the best of all organic compounds studied, although tests made did not result in complete cyanide reduction. It was found that the amount of cyanide removed was dependent upon the amount of acetaldehyde added and the reaction time. The effect of the concentration of ferrous salt and solution pH upon the removal of cyanide have also been investigated. The amount of cyanide lost to the atmosphere was found much greater than the amount of cyanide complexed.

A very interesting approach to the cyanide disposal problem has been proposed by *Morris Bishay* of Purdue University and is now being studied. Certain types of yeast contain the enzyme cytochrome which is present in the red blood cells and, since cyanide inhibits the respiratory functions of human beings by combining with cytochrome oxidase, it is possible that a yeast may be used to tie up the cyanide prior to disposal.

Effect of Plating Wastes on Sewage Treatment Plants:

A thorough investigation of the effect of plating room wastes on sewage treatment plants has not yet been made, and this is admittedly a complex problem. The interest in this area of research is shown, however, by the fact that projects are under way at Ohio State University and Michigan State College and have been considered at Pennsylvania State College.

Ohio State University[9] has constructed a 50 gpm pilot plant incorporating 3 biological treatment units; (1) trickling filter, (2) activated sludge, and (3) sludge digestion tank. A study of the effect of plating wastes on these processes is planned with screening tests on the effect of chromic acid on the trickling filter well underway. As much as 2 ppm of chromium has not shown any effect. *W. D. Sheets* reports that, within several months, there should be more complete data on the effect of chromium on the trickling filter and that the activated sludge processes and the sludge digestion tank will be in operation soon. Metal, cyanide, etc., will be studied with respect to shocks, cumulative effects and developed resistance.

Two pilot-plant trickling filters have been constructed and are in operation at Michigan State College under the direction of *Dr. C. Fred Gurnham*. The title of the project, supported by a U. S. Public Health Service grant, is "Pilot Plant Investigation of the Effect of Cyanides and other Toxic Substances on the Trickling Filter Process of Sewage Treatment."[10] The pilot plant filters have been broken in and preliminary studies on cyanide dosage (0.3 and 1.0 ppm of cyanide) made. Cyanide toxicity studies are presently being conducted on various trickling filter organisms. Several species tolerant to 20 and even to 200 ppm of cyanide have been isolated. The mechanism of cyanide destruction in the trickling filter and the kinetics of such reactions as well as the effect of higher cyanide dosages are matters under study now. This work will be reported by Dr. Gurnham when sufficient data become available.

Toxicity

A considerable number of metallic and other ions

used in the metal finishing industry are known to be toxic. There is little agreement in the literature with respect to lower limits of concentration for fish or micro-organisms, so that continuing research is necessary. A very complete critical review of the literature on the toxicity of industrial wastes and their components to fish was published[11] July 1953, so a discussion of this subject would only be repetitious. However, it should be mentioned that studies are in progress on toxicity by the U. S. Public Health Service on fish physiology and toxicology related to industrial waste pollution and at Kettering Laboratory on the establishment of toxicological limits and standards for chemicals present in industrial wastes from the hygienic standpoint. A sub-committee on toxicity limits of the Metal Finishing Committee of the Ohio River Valley Sanitation Commission has abstracted over 1,000 articles on toxicity of metal finishing wastes to man, animals, and aquatic life.[12] This work is being evaluated by Kettering Laboratory and the Aquatic Life Advisory Committee.

Analytical Methods

Analytical methods for the determination of plating waste constituents have been developed and evaluated by a number of workers. Perhaps the greatest amount of work has been done by *E. J. Serfass* at Lehigh University, first under Project No. 2 of the AES (in cooperation with Project No. 11 under *B. F. Dodge*) and later for the Ohio River Valley Sanitation Commission. This work has been evaluated by cooperating laboratories and has been released as a manual entitled "Methods of Analysis for Metal Finishing Wastes."

Committee D-19 of the American Society for Testing Materials is also concerned with analytical methods for waste constituents. Preliminary work on the determination of free (released by acetic acid) and total cyanide in effluents has been carried out by Chamberlin and Davis under *W. M. Cline, Jr.*[13] who is chairman of Task Group 12, Section B, of D-19 Sub. III. The method used was essentially the pyridine-pyrazolone method (Epstein) as modified by Serfass and good checks were obtained with the least accuracy generally for solutions containing ferro- and ferricyanides.

It might be pointed out that there is still need for clarification with respect to whether total cyanide, including ferro- and ferricyanides, is a useful one to make on effluents or whether a method for all cyanides except the very stable complex iron cyanides would be more to the point. This will probably be resolved as the result of toxicity and hydrolysis studies in the future.

Considerable work in the field of cyanide - cyanate analysis has been carried out in the laboratory of the Welsbach Corp.[14] Ammonia is determined using the pyridine-pyrazolone method (with precautions when cyanide or thiocyanate are present). Cyanate is hydrolyzed to ammonia and determined as such. The Epstein method is also recommended for cyanide by this laboratory with tartaric acid being used to eliminate the cyanide. It is interesting to note that the ASTM D-19 Task Group prefer acid distillation with cuprous or magnesium and mercuric chloride prior to employing the Epstein method on effluents containing metal cyanide complexes.

Acid Wastes

The problem of pickle wastes, although not of the magnitude to the metal finishing industry that it is to other groups, e.g. steel, aluminum, brass, etc., is one that the metal finisher must know how to solve. For this reason it is in order to refer briefly to work being done on pickle liquor disposal.

Rutgers University has for a number of years carried out work on lime neutralization. Several papers on this subject were presented at the Seventh Industrial Waste Conference and Professor Orford reports[15] that, at this time, the effects of contaminants and other ions on the neutralization of sulfuric acid with lime are being studied. Work is planned dealing with phosphoric acid neutralization and plating waste treatment. It might be added that a paper several years ago from this laboratory[16] described the use of lime for treating copper pyrophosphate plating wastes, showing high calcium lime best of a number of alkalis for copper removal.

The disposal of waste pickle liquors is a continuous problem which, heretofore, has been dealt with by neutralization, disposing of the sludge by lagooning, sedimentation or vacuum filtration. In recent years the regeneration of waste acid solutions has been investigated not only to reduce the material cost in pickling, but also to reduce or eliminate the disposal problem.

In 1946 *Edmond R. Thews* suggested three theoretical systems for the regeneration of super-concentrated pickling solutions.[17] These systems involved (1) electrolytic deposition of iron and regeneration of the acid solution, (2) precipitation of the ferrosulphate contents in excess of 5 or 6% iron by physical process and regenerating the acid solution, and (3) separation of the entire ferrosulphate content by addition of alcohol and regeneration of the acid solution.

In the second system the iron was crystallized out by freezing. The general principal of this process is that part of the pickling solution is drawn off continuously directly through a regenerating system where the ferrosulphate is precipitated in crystalline form and the liquor containing 5 or 6% iron returned to the process after adding the required amount of fresh acid. In the third system, alcohol diluted with three times its own volume of water is added in the amount of one gallon of such mixture to ten gallons of pickling solution which has been cooled to room temperature. The solution is stirred thoroughly and the iron crystals formed are permitted to settle or are removed by filtration. From the liquor containing about 0.1% iron, the alcohol can be removed by fractional distillation while the liquor is then reacidified to full strength.

At the 9th Industrial Waste Conference, Messrs. Horner, Winger, Brodamer and Kunin of the Rohm & Haas Co. presented a paper on the electrolytic treatment of waste iron pickle liquor with Permselective membranes. A similar paper was presented by other authors[18] at the 125th National meeting of the *American Chemical Society* in Kansas City, Mo. last year. This system employing the separation of electrode solutions by ionic membranes of selective characteris-

tics is extremely interesting, but will not be discussed in this paper.

At the ACS meeting in Kansas City in March, 1954, *Dr. E. Tooper*[19] presented a paper on the treatment of steel mill pickle liquor by ion exchange. This paper described a cation exchange method of treating spent sulfuric acid pickle liquors. In operation, ferrous sulphate is converted to sulfuric acid in equivalent amounts of hydrogen ion from the resin for ferrous ion from solution, accomplishing recovery of the sulfuric acid present in the spent liquor. The purified acid solution can then be recycled to the pickle tanks for reuse. Hydrochloric acid is used as a regenerant of the cation unit resulting in reuse of the recycled acid as a regenerant following evaporation. The remaining solution is ferrous chloride which can be chlorinated to obtain ferric chloride. The final residue consists of iron oxide.

Ion exchange has been investigated as a means of regenerating spent diluted nitric acid etching liquors.[20] Removal capacities average approximately 2 pounds per cubic foot of resin with approximately 60% removal which is sufficient to maintain the iron concentration below a maximum value which would influence the rate of etching.

A description of the work of *Dr. Ralph McCormack*[21] at the University of Detroit involving a continuous countercurrent ion exchange unit for the removal of copper from dilute copper sulphate solutions was described in *Mechanical Engineering Progress* in August, 1953. This method consists essentially of endless beds of ion exchange resin enclosed in a porous flexible casing which is moved slowly through three tubular reservoirs - - a feed exchange, a regenerating solution and a rinse section. This work is continuing with a new apparatus.

Dr. McCormack also investigated the recovery of chromium by extraction with a ketone. This study was concerned with chromic acid recovery from waste phosphating solutions and included acidification to 3 N with hydrochloric acid, extraction with methyl isobutyl ketone (ketone to water of 1:3) followed by aqueous extraction. Considerable concentration can be effected by this means but the hydrochloric acid must be recovered to make it economical.

With the movement of industrial plants into urban areas the simple and sometimes unsuccessful method of lagooning wastes must be replaced by systems involving less area. In the neutralization of many wastes, the resulting precipite can be recovered in sedimentation systems or removed by vacuum filtration. Sedimentation systems are principally useful on batch type treatment; however, the space requirement is considerably greater than that required for vacuum filtration. Studies of sludge characteristics are under way[22] in an effort to evaluate filtering characteristics, quantity and type of sludge produced and simple methods of predicting the most suitable filtering procedure.

Treatment of Mixed Wastes

Most electroplating shops contain a variety of aqueous solutions of different compositions which would include chromic acid, nickel sulphate, nickel chloride, cyanides, metallo cyanides such as copper, zinc and cadmium and alkaline cleaners. Such a variety is necessary to produce different types of finishes to fit specific requirements. Because of the previous lack of interest in recovering valuable materials from wastes and the absence of the need of removing toxic materials from such waters, it has been customary for the great majority of such plants to mix their waste waters. It would be extremely difficult and costly for small plants in existence to separate their wastes, which accounts for the interest in suitable economic methods of treating special wastes.

Recently *C. F. Paulson* presented a paper at the Purdue Conference[23] on the combined use of ion exchange with destruction methods for treating mixed wastes containing cyanides and chromates. In operation, the waste waters were recycled producing an effluent water of better quality than the existing supply of raw water. The waters containing wastes were pumped through a cation and anion exchanger in series, returning the demineralized water back to the plating room for reuse. In regenerating the anion and cation column, alkaline and acid wastes were collected and treated in the usual manner by oxidization and reduction with the usual adjustments of pH to destroy the toxic materials. After settling, the supernatant liquid was discharged to waste and the sludge directed to a lagoon or filter. This system effectively concentrates toxic wastes for destruction and at the same time conserves water and permits the use of a better quality water which has numerous advantages in the plating operations.

Practical Research

Plant design research in many instances is concerned with more than one waste treatment problem. For this reason, this section of the paper will break down recent research work in terms of the location of the activity in order to avoid confusing cross references. Admittedly, there has been considerable design work which is unpublished and unavailable, but it is hoped that what can be reported will be interesting and will indicate trends.

There are two approaches to the waste treatment problem: (1) destruction or conversion of undesirable materials followed by removal and (2) recovery of both pollutants and the water for re-use.

Dr. L. Weisberg[24] has commented on the importance of the second method and outlined some of the factors considered in setting up a waste disposal system at Channel Master Corp., Ellenville, N. Y. "The approach to the plating waste problem is to consider whether or not there is any possibility of salvage. In this connection, consider not only the plating material itself but also the water in which it is dissolved. Chemical recovery often goes hand in hand with a possible re-use of water. The resulting economy in the use of water may represent a substantial part of the total saving, especially in those situations where water is either scarce or expensive.

"Destruction of plating wastes by chemical treatment has a certain appeal where capital is limited, because the first cost of equipment for this method of dealing with the problem is sometimes less than the cost of equipment for recovery. On the other hand, operating costs for destruction represent a dead loss with no offsetting credits. There is not only the cost of chemicals for destroying the plating material, but in

addition the destroyed material itself has to be replaced.

"Recovery of plating wastes begins with good rinsing. Recovery cannot succeed without efficient rinsing. Two things are required in the design of the rinse system. First, as much as possible — one might even say virtually all — of the plating solution carried over on the work and work racks must be washed off so it can be returned to the recovery system. In the second place, if there is an evaporation step in the recovery operation, the rinse waters going to the evaporator must be as concentrated as possible in order to keep steam requirements within economic limits.

"The rinsing method which best meets both these requirements is the counter-current series arrangement. The simplest example of this arrangement is a multi-compartment tank with water flowing through the compartments in a straight line from one end of the tank to the other end in a direction opposite to that in which the work is moved. The performance of such a set-up can be calculated by means of a material balance when one knows the ratio of rinse water to drag-out, the number of washing stages, and the degree of mixing that may be expected. The last item introduces an element of uncertainty, which can be partially overcome by making calculations for various degrees of mixing ranging from extremely good to extremely bad.

"On the basis of numerous calculations, it appears that most situations can be handled with 3 to 4 stages of counter-current rinsing without using a wash water to dragout ratio of more than 10. This brings the steam requirements for evaporation down to a reasonable figure. Where the total amount of water to be evaporated is large enough to warrant the investment — particularly where steam costs are high — steam requirements can be reduced still more by using a multiple effect evaporator.

"The important thing to remember is that the counter-current principle should be adhered to faithfully no matter what combination of tanks and/or sprays are used. Any departure from this principle results in a substantial drop in washing efficiency and a corresponding increase in the water required for rinsing and, where evaporation is involved, an equivalent increase in steam and in condenser cooling water. In recovering chromic acid from rinse waters, however, the counter-current arrangement loses some of its inherent advantage because the highly basic anion exchange resins used for this purpose have not been stable in solutions containing more than 500 parts per million of chromic acid. In general, the smaller the volume of waste to be treated, the less the treatment plant will cost."

The importance of efficient rinsing with respect to satisfactory plating is so important to the plating engineer that oftentimes water is wasted and an inordinate volume of waste is built up. This phase of waste disposal was studied by Ronson Art Metal Works, Inc. with Wigton-Abbott Corporation. The saving in water that could be made by a study of drag-out was reported at the New York Branch of the AES June 17, 1953.[25] A pilot plant was set up capable of handling production racks. Work was run through two lines and, at the end of each day, the rinses were analyzed and a concentration curve was plotted for each tank. System A consisted of three separate tanks being individually fed while System B consisted of a single tank having a velocity of water inflow many times that of all three tanks in System A combined, i.e. 45 gpm for B and 0.03 gpm/tank or 0.09 gpm for A. The plating tank contained a chromium plating solution, 53 oz./gal. CrO_3 and 0.53 oz./gal. of H_2SO_4 and the analyses for chromic acid were done both gravimetrically and spectrophotometrically.

The results obtained are shown in Table I and Table II.

TABLE I

Concentration of Chromic Acid in Each Rinse Tank Versus Time

	System B	System A		
		No. 1	No. 2	No. 3
Start	0	0	0	0
After 8 hrs.	0.005	1.90	0.06	0.002
" 16 hrs.	0.006	2.70	0.12	0.003
" 24 hrs.	0.006	3.30	0.16	0.004
" 32 hrs.	0.007	3.55	0.175	0.005
" 40 hrs.	0.006	3.40	2.205	0.005

TABLE II

Summary

	Equilibrium CrO_3 oz./gal.	Concentration after cycles
Single Rinse Tank	0.00622	5
Tank 1	3.49	180
Tank 2	0.234	390
Tank 3	0.0157	570 (13 days)

Figure 1 shows that the concentration curves of the single rinse tank and of the last tank of the three tank system cross each other on the sixth day and, consequently, only then does the concentration of the third tank become the same as for the single rinse tank. To provide a margin of safety it was decided to dump each rinse every other day. Under these conditions a very appreciable water saving is effected — 17,000 gallons being used per day with the 3 tank system vs. 500,000 gal. per day for the one tank system and the volume of waste can be much more easily treated, either from the standpoint of recovery or destruction.

The two alternatives for cyanide wastes are chlorination, which means destroying the cyanide, or recovery by evaporation. The latter has operating cost advantages but, where there is lack of capital to meet the first cost of the equipment, it may be ruled out. To destroy one pound of cyanide ion takes a minimum of 6¾ lbs. of chlorine and 6¾ lbs. of sodium hydroxide; to recover one pound of sodium cyanide by double effect evaporation requires 70 lbs. of steam and about 350 gallons of 60 degree cooling water. (For single effect, these figures will be approximately 140 lbs. of steam and 550 gallons of cooling water.) It should not be forgotten that evaporation recovers not only the cyanide but the whole plating solution.

Originally, the treatment of plating room wastes was attacked primarily from the standpoint of destruction of these wastes, as shown for cyanide wastes in the bibliography referred to under the "Academic Research" section. This continues to be an important

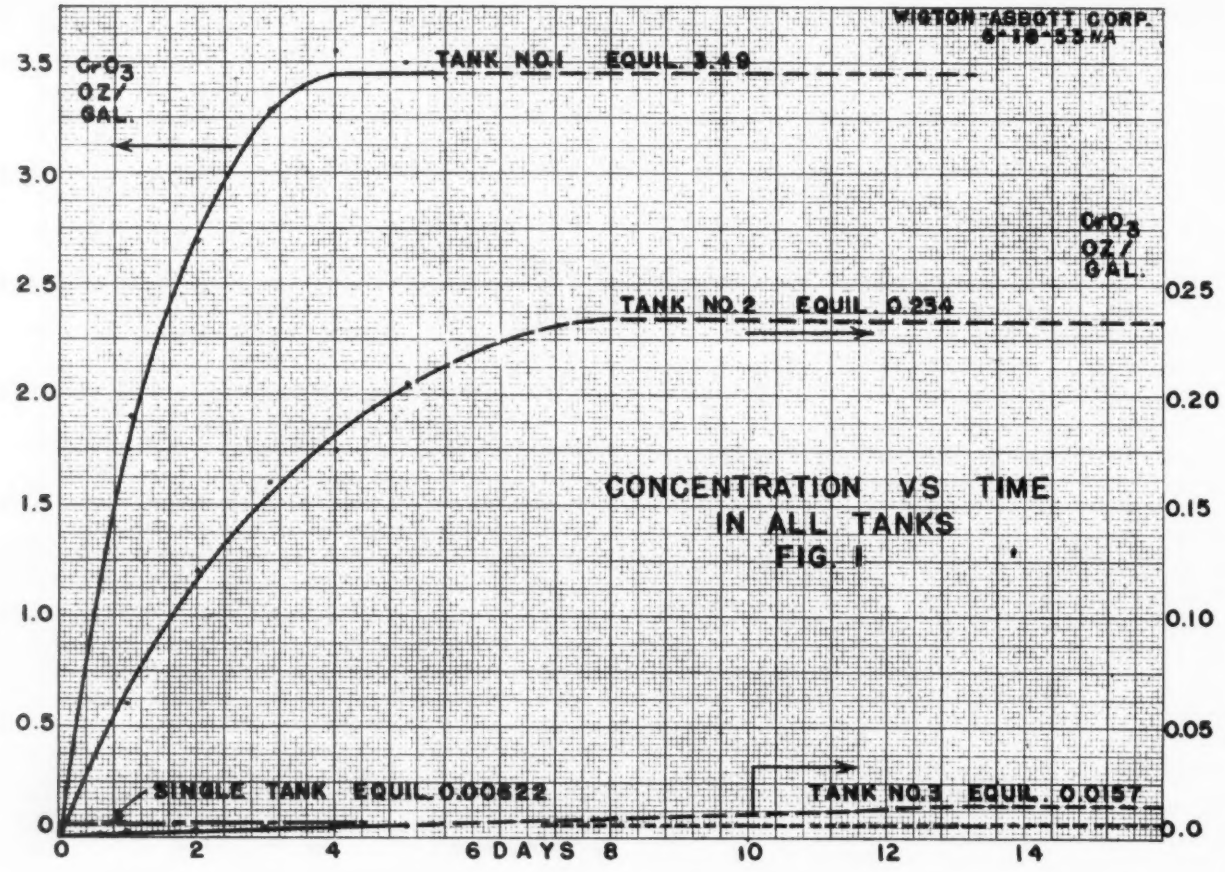

Figure 1

method of attack and Wallace and Tiernan, Bellville, N. J.,[26] have been engaged in research concerned both with the destruction of cyanide and of chromic acid. It has been customary to oxidize cyanides with chlorine at a pH above 8.5 to insure destruction of any cyanate formed. However, at this pH the heavy metal hydroxides are precipated and as much as 40% of the cyanide of the $Ml(CN)_4$ may be dragged into the sludge. This problem has been effectively solved for closed system chlorination by driving the pH down to about 5.0 by injecting chlorine and, under these conditions, the metal cyanide is decomposed to cyanogen chloride and the soluble metal ion. This is followed by a caustic feed to raise the pH to about 11 and insure the formation of cyanate. The amount of chlorine needed can be effectively determined and controlled for any given waste by a redox potential measurement. Furthermore, the amount of chlorine required to completely oxidize the cyanate to $CO_2 + N_2$ is related to the amount required to effect the first stage oxidation (cyanide to cyanate) by a constant factor of about 1.5. Consequently, simple redox control will direct the amount of chlorine required for both steps in the process if the injector orifices bear this relationship (1:1.5). In practice, the pH is brought up to 11.5 prior to the second injection of chlorine to insure rapid oxidation to cyanate. The second chlorine injection reduces the pH below 10 as needed to complete the $CO_2 + N_2$ reaction. This method insures the complete destruction of the toxic cyanide components, provides automatic control of the chlorine used and minimizes sludging out of insoluble material in the piping system. The CN to CNO and the CNO to $CO_2 + N_2$ redox potential curves are both quite sharp, making for good control.

Practical considerations of the oxidation of cyanides and cyanates with ozone have been investigated by the Welsbach Corp.[27] Laboratory tests indicated that, although the reaction was slow, there was no doubt that ozone would oxidize cyanide. The rate of the reaction can be improved by the addition of a catalyst, and, while this did not change the reacting ratio, the rate of absorption was markedly increased.

Equipment is being readied for an installation at the Superior Metals Co. in Bethlehem, Pa.,[28] for the treatment of cyanide bearing wastes prior to the reaction of a portion of these wastes. In operation, 20% of the treated wastes will be bled off to the city sewer and the remainder, mixed with untreated make-up stock, will be returned to the process by way of a storage tank. The reuse of this treated water is made feasible by treatment with ozone which has little or no residual effect.

Wallace and Tiernan have also studied the factors involved in the reduction of chromic acid by sulphur dioxide. The results of this study are shown in Tables III, IV, & V and it is interesting to note that the rate of reaction is slower when excess sulfur dioxide is present than for excess chromic acid. Obviously excess sulfur dioxide is required for complete removal of the hexavalent chromium.

In actual practice, the pH is held near 2 to 3 to

TABLE III

Reduction of Hexavalent Chromium with Sulfur Dioxide

SO_2: Cr Ratio — 2.0 : 1.0

pH Level	*Ratio of SO_2 Applied to Cr^{6+}*	*Time for Completion of Reaction*	*Chromium-Cr^{6+} Left p.p.m.*	*Chromium-Cr^{6+} Reduced p.p.m.*	*Sulfur Dioxide Left p.p.m.*	*Sulfur Dioxide Consumed p.p.m.*	*Ratio of SO_2 Consumed to Cr^{6+}*
1.06	2.04 : 1.0	30 Secs.	11.4	39.3	0	103.3	2.63 : 1.0
1.45	2.13 : 1.0	1½ Mins.	11.6	38.2	0	112.3	2.94 : 1.0
2.00	1.99 : 1.0	6-8 Mins.	12.6	39.8	0	104.5	2.63 : 1.0
3.00	2.18 : 1.0	22-25 Mins.	11.7	40.2	0	112.9	2.81 : 1.0
3.80	2.06 : 1.0	43-48 Mins.	4.9	46.4	0	105.8	2.28 : 1.0
4.98	2.07 : 1.0	7½-8 Hrs.	21.0	31.3	0	108.3	3.46 : 1.0

TABLE IV

Reduction of Hexavalent Chromium with Sulfur Dioxide

SO_2 : Cr Ratio = 3.0 : 1.0

pH Level	*Ratio of SO_2 Applied to Cr^{6+}*	*Time for Completion of Reaction*	*Chromium-Cr^{6+} Left p.p.m.*	*Chromium-Cr^{6+} Reduced p.p.m.*	*Sulfur Dioxide Left p.p.m.*	*Sulfur Dioxide Consumed p.p.m.*	*Ratio of SO_2 Consumed to Cr^{6+}*
0.97	3.30 : 1.0	30 Secs.	0	50.3	36.7	129.4	2.57 : 1.0
1.48	3.24 : 1.0	2-2½ Mins.	0	51.5	28.1	138.8	2.70 : 1.0
2.00	3.16 : 1.0	9-12 Mins.	0	52.0	33.1	131.3	2.56 : 1.0
3.01	2.96 : 1.0	30-35 Mins.	0	51.5	18.3	134.0	2.62 : 1.0
3.85	3.00 : 1.0	60-70 Mins.	0	53.8	36.8	124.3	2.31 : 1.0
5.00	3.29 : 1.0	Infinity	(2.3)	(49.9)	(14.6)	(157.0)	(3.15 : 1.0)

( ) Results at pH 5.00 at end of 5 hours.

reduce the acid consumption as opposed to a slightly higher capital investment resulting in the installation of a larger retention chamber. The SO_2 to CrO_3 ratio commercially employed is somewhat under 3:1.

Hodges[29] has reported on the research carried out and in-plant development experience on chromium, nickel, cadmium, copper and zinc plating wastes. Cyanide wastes were of minor import so the problem in this instance resolved itself into one of eliminating chromium and toxic metals. The pH of the waste was reduced to 2.0, then barium sulfide was added, followed by lime to raise the pH to 7.0. Water containing 75 ppm of chromium required 5-6 lbs. of barium sulfide and 4 lbs. of lime per 1,000 gal. Barium sulfide proved to be difficult to handle (grinding required 65°C. water for solution, etc.) and additional work showed sodium metabisulfite ($Na_2S_2O_5$) to be more satisfactory with about 1.5 pounds required per 1,000 gal. The sludge containing the chromium and other heavy metals is presently being hauled by tank truck to a municipal disposal area.

The effectiveness of the process is shown by the data in Table VI.

TABLE V

Reduction of Hexavalent Chromium with Sulfur Dioxide

Summary Table

Time for Completion of Reaction at Various pH levels

1. With Cr^6 in excess leaving a residual of Cr^6.
2. With SO_2 in excess leaving a residual of SO_2.

pH Level	*1. With Chromium in Excess SO_2 : Cr = 1.0 : 1.0*	*SO_2 : Cr = 2.0 : 1.0*	*2. With Sulfur Dioxide in Excess SO_2 : Cr = 3.0 : 1.0*
1.0	30 Secs.	30 Secs.	30 Secs.
1.5	1-1½ Mins.	1-1½ Mins.	2-2½ Mins.
2.0	5-6 Mins.	6-8 Mins.	9-12 Mins.
3.0	5-6 Mins.	22-25 Mins.	30-35 Mins.
4.0	18-22 Mins.	43-48 Mins.	60-70 Mins.
5.0	1½-2 Hrs.	7½-8 Hrs.	Infinity

TABLE VI

Chromium Reduction with Metabisulfite

Sample No.	*Raw Composite pH*	*Raw Composite ppm Cr^{6+}*	*Raw Composite ppm Ni^{2+}*	*Treated Composite pH*	*Treated Composite ppm Cr^{6+}*	*Treated Composite ppm Ni^{2+}*
1	3.9	28	112	6.5	0	4.6
2	5.15	25	84	6.95	0	5.6
3	4.95	19	120	7.98	0	0.7
4	6.5	31	27	8.0	0	10.0
5	6.12	26	23	9.4	0	0
6	6.38	47	21	8.47	0	2.4
7	5.58	29	18	10.0	0	1.5

For some years the evaporation of chromic acid wastes has been a means of partially recovering much of the chromic acid lost from the plating tank through drag-out. The disadvantage of such a system is found in the concentration and recovery of troublesome contaminants which would otherwise be discharged into the sewer. The effect of contaminants such as copper, iron, zinc, trivalent chromium, etc., upon the operating conditions of a chromic acid plating solution and upon the deposits produced therefrom result in evaporation practiced only on a limited scale. The effectiveness of the evaporation and the limits to which it is used are influenced by the concentration of contaminants recov-

ered with the chromic acid. The use of a cation exchanger operated in the acid cycle to remove or reduce these troublesome ions is practical,[30] provided that the concentration of the chromic acid does not exceed approximately 100 grams per liter. Capacities of the exchange material are approximately 40 to 45 ounces of metallic impurities (calcium carbonate per foot) at an acid regeneration level of approximately 25 lbs. of 66 Deg. Bé sulfuric acid. These capacities will vary somewhat depending upon variations in the chromic acid concentration and the contaminant load so that each individual case must be evaluated to obtain actual capacities under the load conditions. An illustration of the cation exchange unit is shown in Figure II and a flow diagram of the process is shown in Figure III. Similar systems have been evaluated and put into production for the removal of aluminum and trivalent chromium from chromic acid anodizing solutions and for the removal of copper and iron from chromic acid stripping solutions.

While acids are generally mixed with alkaline waste cleaners prior to disposal, there are some heavy pickling operations where waste alkaline materials are not available. In addition to conventional disposal systems utilized by large consumers of acids such as steel mills, in-plant research has actively pursued suitable methods of recovering such wastes. The Blaw Knox Co. announced a new process to recover the entire sulphate content of waste pickle liquor[31] as reusable sulfuric acid without producing other undesirable by-products which might present a disposal problem. In this system the spent liquor is sent to evaporators where it is concentrated to ferrous sulfate and then converted into ferrous chloride by absorption by hydrogen chloride gas. The ferrous chloride precipitates are removed from the spent pickle solution by centrifuging. An equivalent quantity of sulfuric acid is generated in the reaction of hydrogen chloride with the ferrous sulfate. Ferrous chloride is roasted, yielding hydrochloric acid, and iron oxide can be charged into the furnaces and the regenerated pickle solution returned to the pickling line.

The waste treatment installation recently put into operation at the Sherrill plant of Oneida, Ltd.,[32] made use of a considerable amount of data accumulated by AES project #10 and was reported in detail at the New York AES convention in July by *Dr. B. F. Dodge* and *Dr. Charles A. Walker*. Certain wastes from the Oneida plant complicate the problem somewhat because of the presence of silver which must be recovered. Consequently, the final design resulting from laboratory and pilot plant research included holding tanks for acid, alkali and silver bearing wastes. The silver waste holding tank is first treated with sodium hypochlorite at pH 10.5 to form cyanate and precipitate silver chloride. The silver chloride, however, is in such highly divided form that the method was modified so that the oxidation is carried out in the presence of silver chloride from previous batches, resulting in particle growth rather than new nuclei formation. After several batches have been treated, half of the precipitated silver chloride is removed to a 2,000 gallon tank, acid treated and refined to silver. The alkali waste is adjusted to a pH of 10.5 using acid wastes or lime slurry, whichever is required, and the cyanides are oxidized to cyanates. The cyanate bearing wastes from the silver treatment holding tank are pumped into an alkali waste cyanide treatment tank. The oxidation is complete after 10 to 15 minutes, following which the pH is lowered to 6.5-7.0 and the oxidation to CO_2 and N_2 is completed in another 10 to 15 minutes. Plant operation has demonstrated that the two stage oxidation is superior to the pH 8.5 oxidizing procedure.

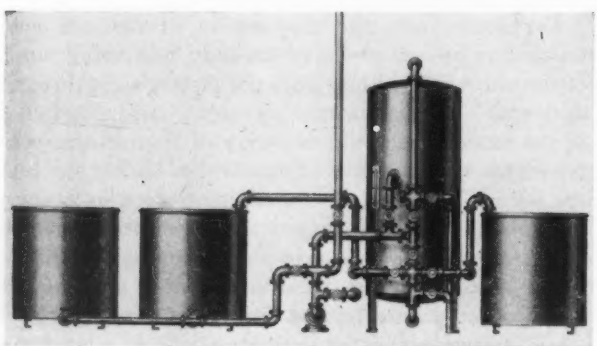

Figure 2

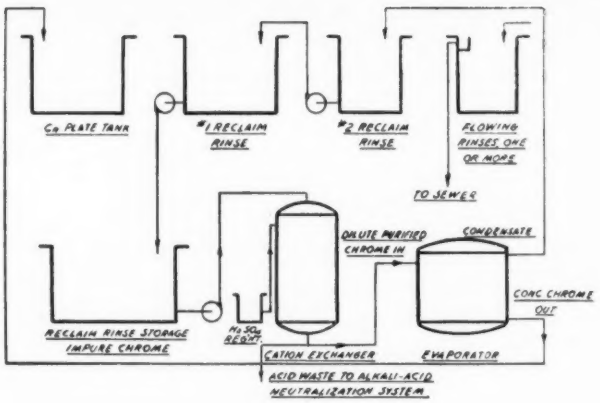

Figure 3

Conclusion

Recent activity concerned with the treatment of metal finishing wastes is considerable, as demonstrated by the fact that nine out of forty-five papers presented at the Purdue conference apply either directly to plating effluents or to very closely related fields.

It is felt that future research will be concerned with the development of improved or new methods of treatment designed wherever possible to save water and chemicals, the study of toxicity limits to permit the establishment of reasonable standards, the determination of the effect of plating wastes on municipal sewage treatment processes, the development of better control methods as required and, of course, the practical research concerned with the improvement of the equipment required to apply waste treatment processes to industry's problems.

Finally in any paper of this type recognition should be made of the contributions of educational institutions, technical societies, governmental agencies such as the Ohio River Valley Sanitation Commission, the

United States Public Health Service and the National Technical Task Committee on Industrial Wastes towards a solution of the pollution problem; a matter no longer of interest primarily to followers of Isaac Walton, but to all concerned with the welfare of the United States. It can truly be said that waste water is a water resource.

Addendum

Other papers presented at the Ninth Purdue Conference of Industrial Waste included a discussion of waste at Fairless Works by Howell, disposal of waste pickle liquor by Heise and Johnson, the waste treatment works at Buick's jet engine plant by Brink, the application of ion-exchange to plating plant problems by Colise and O'Conner, and by D'Orazio who also discussed vacuum evaporation, waste treatment at the Ternstedt Division by Delos and Maytag's plating waste treatment plant by Hoppe.

The Oneida, Ltd. plant was the subject of a number of articles[33, 34, 35, 36, 37] while the disposal of wastes at the Fairless Works,[38] the Erie plant of General Electric[40] and the disposal system at Riverbank Ordnance[39] were also described.

L. E. Lancy[41, 42] described the integrated treatment of metal finishing wastes and the broad waste disposal problem facing the electroplater, and *S. Wernick*[43] also commented on the latter problem. *J. B. Mohler*[44] discussed the use of counterflow rinse systems, *T. S. Powell*[45] the re-use of sewage water and *E. Blount* discussed the recovery of nickel[46] as conservation measures. A rather complete review of ion-exchange covered resins, equipment and applications, including 56 references[47] and an ion-exchange conference in London was of interest.[48]

Public Law #845 and the National Technical Task Committee on Industrial Wastes was discussed by Gurnham[49] and Orsanco's contribution toward solving the pollution problem, including the announcement of the release of the manual "Analyzing Metal Finishing Wastes" was reported by Reed.[50]

Analytical methods for zinc,[51] copper,[52] iron[53] and nickel[54] were reported by Serfass et al. and a method for testing for cyanide using 1-phenyl-3-methyl-5-pyrazolone was patented by Falkof.[55]

Patents issued during the year include two for the removal of silica, one by ion-exchange[56] the other by precipitation.[57] Other ion-exchange developments include an improved apparatus[58] and a method for the removal of thiocyanates.[59, 60] A method for the removal of grit and grease was the subject[61] of a patent and a chlorinator was described,[62] as was a method for the disposal of waste pickle liquor[63] by adding alkaline earth oxides and oxidizing the ferrous salts (2-5%) to ferric to assist filtration.

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Rinsing Techniques

By Joseph B. Kushner, *Director, Joseph B. Kushner Electroplating School, Stroudsburg, Pa.*

RINSING is one of the most important operations in the plating room, yet it is the one which is most frequently neglected, at the cost of poor results, solution contamination, excessive use of water and uneconomical waste treatment. Why this should be so is difficult to fathom, except that the subject is so obviously simple, involving as it does the use of ordinary water, that there just doesn't seem to be anything very special about it— so we get careless and sloppy! In a way it is like driving a car on a flat, wide, curveless stretch of turnpike. On these straight, monotonous stretches of highway, we tend to pay less attention to our driving because there seems to be nothing to it. The statistics show however, that most accidents and costly crack-ups occur on these monotonous, flat, straight highway sections! Likewise, rinsing is the easy part of the road between the entering work and the finished product. If we don't keep both hands on the wheel and our eyes on the road, we may run into trouble!

In the rinsing process, the object is to flush away all clinging solids and dissolved salts from the work. An efficient housewife may use two gallons of water to get her dishes sparkling clean; a sloppy homemaker may use ten or even twenty gallons of water and not do as good a job. Likewise in plating work, you may be able to do an excellent rinsing job with ten gallons of water whereas someone else won't get as good a result with one hundred! What is the secret? Attention to some simple rules.

Rinsing does not mean dipping an item into a tank of water and pulling it out.

It means: 1. Turbulent relative motion between the work and the water. 2. An adequate period of contact between the work and the water. 3. The presence of sufficient water during the contact period to properly reduce the concentration of the salts that are washed off the surface. These three principles hold for any rinsing operation.

Adequate Agitation

The first principle involves the use of agitation of some sort. This agitation may come from:

1. The direct flow of water.
2. Manual motion of the work.
3. Mechanical motion of the work.
4. Blowing air through the water.
5. Recycling or pumping the water.
6. Propeller agitation.
7. Vibratory agitation (sonic & ultrasonic).

The first method is the least efficient one with respect to water use yet is the one most frequently found in plating plants! The faucet is turned on all the way and the water running in and out of the rinse tank is supposed to do the job of washing the work surfaces. This type of rinsing is inexcusably inefficient. It is inefficient because using the direct, continuous flow of water to supply the necessary agitation, wastes from ninety to ninety-eight percent of the water used!

There are only two exceptions in which direct water flow can be efficiently used for rinsing. These are for *spray rinsing* and *flood rinsing*.

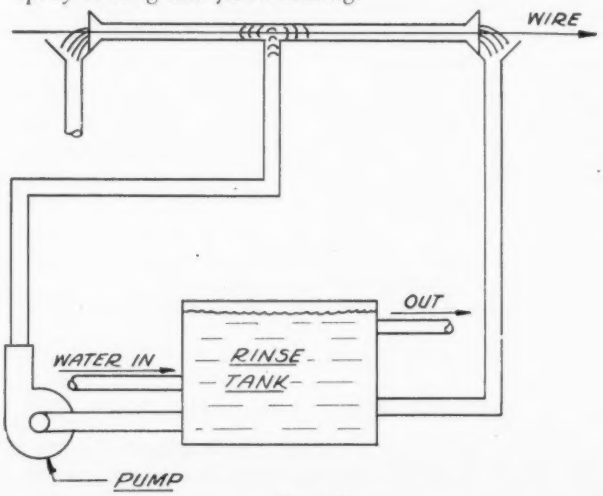

Figure 1

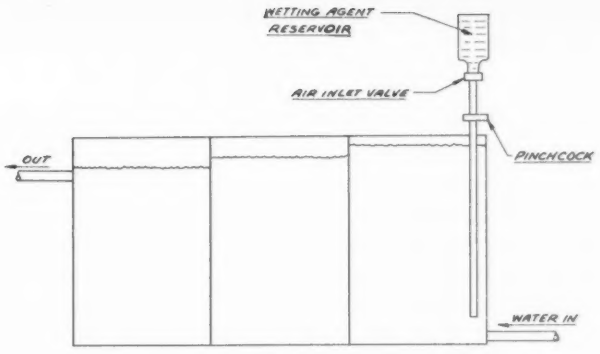

Figure 2

In *spray rinsing*, the work is placed in a rinsing cabinet and water impinges on the work in the form of high velocity jets. With good nozzles, water pressure of 45 psi, such as is found in most municipalities, will give a satisfactory high velocity spray. This gives good rinsing and uses from ½ to ⅛ of the amount of water that would be required for equivalent dip rinsing. The only drawback the method has is that it won't give good rinsing when there are recessed or hidden surfaces on the work.

In *flood rinsing*, the work is held in a stream of water which is flowing from a pipe which has been connected with a simple air entrainer or aspirator. By pressing on a foot valve, you can suddenly release a torrent of water and air bubbles on the work. The air bubbles materially increase the effectiveness of the water by increasing the turbulence and by helping to displace some of the plating solution from the work surface. This method likewise gives good rinsing and does not use too much water because a large volume of air is mixed with the water and the water is on only when the work is in the stream. It is generally suitable however, for small work that can be readily maneuvered in the stream.

The second method, manual motion, can be good when the operator is conscientious and really "swizzles" the work, but it's not a reliable one because the amount of agitation will depend on what the operator had for breakfast and what he has on his mind!

The third method, mechanical motion of the work is something that cannot be recommended very highly, because the agitation obtained from a moving bar across the rinse tank is not enough for real turbulence. If you are willing to spend more time in the rinse tank with the work then this type of motion will be O.K. If you aren't you have to look around for something more effective.

The fourth method is probably the best all around method for obtaining good rinsing. The air bubbles really shake up the water and help dislodge the plating solution from the work. Clean, filtered air can easily be blown in through the bottom of the tank through a distributor pipe and, if needed, additional air can be forced into the water by using an air entrainer on the water feed line.

The fifth and sixth methods are used only for special purposes and are usually not as efficient as the air blower method for agitating a rinse tank. There are certain situations, for example in the rinsing of an easily oxidizable surface such as copper, where air cannot be used, and here propeller or pump agitation will work well provided it is arranged so that a minimum of air is sucked in. Shown in Fig. 1 is a pumping arrangement for the highly efficient rinsing of wire in a wire plating machine developed by the writer in 1942.

The seventh method which makes use of sonic or ultrasonic vibration to produce the necessary turbulence is only of academic interest at the present time inasmuch as such a method would be far too costly for producing agitation for rinsing with water. However, as is now well known, ultrasonic vibration does a good job in the cleaning of small objects where alkaline and organic degreasers are used.

Adequate Contact Time

The time of contact between the work and the water will depend, of course, on how effective the diffusion-mixing process is in the rinse tank. If there is good agitation and a wetting agent is present, ten seconds may be enough in the rinse water; if there is poor agitation and the geometry of the work hinders diffusion, minutes may not be enough. Generally, with good agitation, ten to twenty seconds in the rinse tank will be sufficient.

In discussing the principle of adequate contact time between the work and the water it is presupposed that there is good contact between the work surface and the rinse water at all times; this however may not necessarily be so and for this reason a wetting agent is an invaluable aid in promoting good rinsing.

Wetting Agents Assist Good Rinsing

Since good rinsing involves intimate contact between the work surface and the rinse water, the use of a suitable wetting agent in the rinse water which promotes intimate contact with and displacement of the concentrated solution film, will greatly improve the rinsing qualities of ordinary water. In addition, if air is being used for rinse tank agitation, the wetting agent will materially increase the number of air bubbles formed to further aid the process. Since only about 0.02% by weight of the best wetting agents are needed to do such a job, a simple automatic liquid feeder can be used to dispense the wetting agent into the rinse tank. It is quite economical to use such a scheme, particularly if you use three or more rinse tanks in series as described in a later section. For example, if with a three rinse system you use 0.2 gpm of water, it means you will use $60 \times 0.2 \times 8.3 = 100$ lbs. of water per hour which will call for 0.02 lb. of wetting agent per hour or about 2.5 oz. per eight hour day. In Fig. II is shown the principle of a simple drop type feeder. More expensive aspirating types can be employed but this will do the job just as well for the purpose needed.

Hot and Warm Rinses Are More Effective

Since heat speeds diffusion processes and rinsing is based on diffusion, warm and hot waters will be more effective in rinsing than cold waters. Hot rinses are of particular value where they follow cleaning and plating baths that tend to "freeze" on the work as the solution dries. Rinsing in cold water after such a bath may "set" the film of salts and make it harder to remove, causing trouble in a later process. Occasionally just the reverse

may be true but this is rare. Where decomposion of the salts by hydrolysis is a factor, cold rinses usually have to be used after a plating bath containing such salts. Examples of this can sometimes be seen in tin and rhodium plating. Sometimes hot rinses cannot be used with sensitive metals as they may cause staining. Or it may be found of advantage to feed a very small amount of sulfuric acid into the rinse water to keep it slightly on the acid side, for example, in working with copper plated surfaces or copper basis metal.

Correct Water Volume

This point is the one usually treated most carelessly by many platers and is the one on which two important factors hinge: 1. Reduction of water costs. 2 Reduction of waste disposal costs. The goal to be achieved here is to get the most rinsing out of the least amount of water. More frequently the exact opposite is what is found!

Examine the diagram of a simple rinse tank shown in Fig. III. Water flows into the rinse tank at a rate of Q gallons per minute and out at the same rate. Plating solution, however, except in the case of wire and strip plating, is ladled into the tank on the work, in discrete, integral units and the mixture of solution and water is likewise removed on the work in these same integral units (dragin-dragout). The build up of salts in such a rinse tank follows the pattern shown in Fig. IV. When the equilibrium state is reached we will have a sort of wavy horizontal line which looks like this because the amount of salt we are washing off each rack will just be removed by the water flow during the time interval to the next rack. The height of this wavy line above the base line, which is known as the equilibrium concentration, is given with an approximation suitable for most plating calculations* by the relationship:

$$C_e = \frac{\ominus}{W} C_o \qquad (1)$$

Where C_e is the equilibrium concentration, $\ominus$ is the dragout (volume) per unit time and W is the total amount of flowing water used during the interval between racks ($W = pQ$, where p is the time interval between racks in minutes and Q is the rinse water flow in gallons per minute), and C_o is the concentration of salts in the dragin.

The ratio C_o/C_e is known as the *rinsing criterion*, R, because it is a measure of the effectiveness of the rinsing (obviously, the larger R is, the better the rinsing). In terms of formula (1) then,

$$R = \frac{W}{\ominus} \qquad (2)$$

so that the quality of the rinsing will depend on the ratio of total water flow during the time interval between racks and the dragin on the rack during the same interval.

A simple example will make clear the working of the relationship. Suppose you are operating a 53 oz./gal. chromium solution which is followed immediately by a single running rinse. A few tests show that the rinsed work will stain or appear discolored unless the concentration of chromium salts on the work leaving the rinse tank is 0.005 oz. per gal. or less. Accordingly, the required rinse ratio is 53/0.005 or 10,600. To continue with the example, if the dragin is equal to say 0.01 gallon per rack, then we will need at least $0.01 \times 10{,}600 = 106$ gallons of water flowing during the time interval between racks. If there were a short space of time between racks, say 2 minutes, a water flow rate of 53 gallons per minute would be required! You can see at once from this simple example that a single rinse tank can be enormously wasteful of water. It is so enormously wasteful because, to accomplish its purpose, a very large volume of water must run in and out of the tank when there is no work in it!

The only way to overcome this waste is to increase the efficiency of the process by getting more rinsing work out of the water that flows between rinses. This can be done only in one way and that is to increase the number of rinse tanks. If we use a series of rinse tanks for a given rinsing operation we are in effect holding back the water a bit on its way to the sewer, so that we can get more work out of it. It is like putting up a dam on a river so that we can get more out of the water in the way of energy and irrigation, instead of letting it wastefully run to the sea.

If we use a number of rinse tanks in a row it is very easy to demonstrate that, if n is the number of rinse tanks used and C_n is the concentration of salts in the last or nth rinse tank, then

$$C_n = (\ominus/W)^n C_o \qquad (3)$$

and, since now C_o/C_n will be equal to R, we can write

$$R = (W/\ominus)^n$$

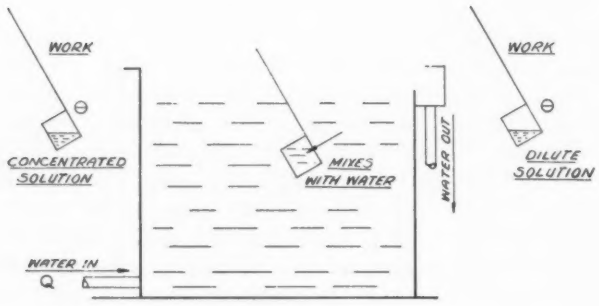

Figure 3

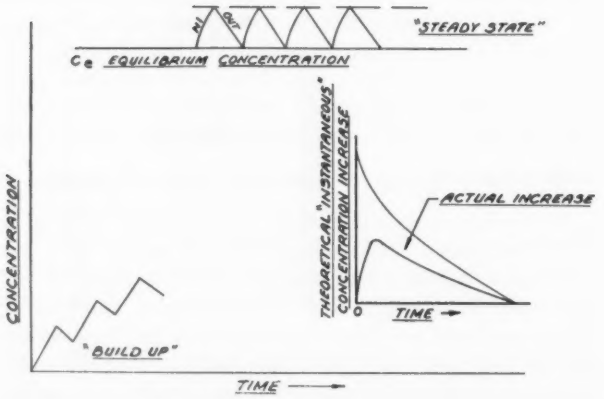

Figure 4

*See reference 7 for exceptions.

and, if we wish to solve for the total amount of water needed per interval, W, we get:

$$W = \ominus R^{1/n} \qquad (4)$$

This relationship which was derived on the basis that the rinse tanks are fed in multiple but which holds for cascade fed tanks as well, shows what a great water saving can be achieved in obtaining a given rinsing result. Let us go back to the first example. Suppose instead of having one rinse tank after the chromium bath we have three in series. The cube root of 10,600 is roughly equal to 22 so that $W = 0.01 \times 22 = 0.22$ gallons! And if there is a time interval of two minutes between racks, the actual required water flow would be $0.22/2 = 0.11$ gallon per minute! If the tanks were not cascade fed but rather were multiple fed so that each tank had its own fresh water supply, the amount of water flow to each tank would be 0.11 gpm and a total of $3 \times 0.11 = 0.33$ gpm would be all required.

The enormous water savings and concommitant savings in waste treatment possible, as illustrated by this simple example, are not a theoretical pipe dream. It is a proven fact, verified by actual experience. Hendel, for example showed that by using a triple multiple feed rinse instead of a single rinse, following a chromium plating bath he was able to cut a veritable Niagara of 750,000 gallons per year needed for this *one* tank, down to a relative trickle of 17,000 gallons per year for the *three*. And if the tanks had been cascade fed, it could have been cut to only 5700 gallons per year!

Of course, it must be remembered that when the water flow is so drastically reduced, you cannot get the necessary agitation for the rinsing process from the water flow and it must be obtained by one of the means previously outlined. The small cost of operating an air blower system, a pumping system, or a propeller system of agitating is more than overbalanced by the large savings made possible in water consumption and waste treatment.

A nomograph of equation 4 is given in Fig. V, to simplify calculations with this equation. With its use almost any problem in rinsing can be solved.

Some Additional Factors in Rinsing

SIZE OF RINSE TANKS:

Everything else being equal, rinse tanks should be as small as possible, compatible with easy handling of the largest load to be rinsed. Using a huge rinse tank does not necessarily mean you are geting good rinsing. When you are using a smaller rinse tank it means that, for a given water flow rate, you are getting better mixing and are carrying away the rinse product faster. It is also wise to have all the rinse tanks of a uniform size when you have them in series. This gives the most effective rinsing job for a given allotted space.

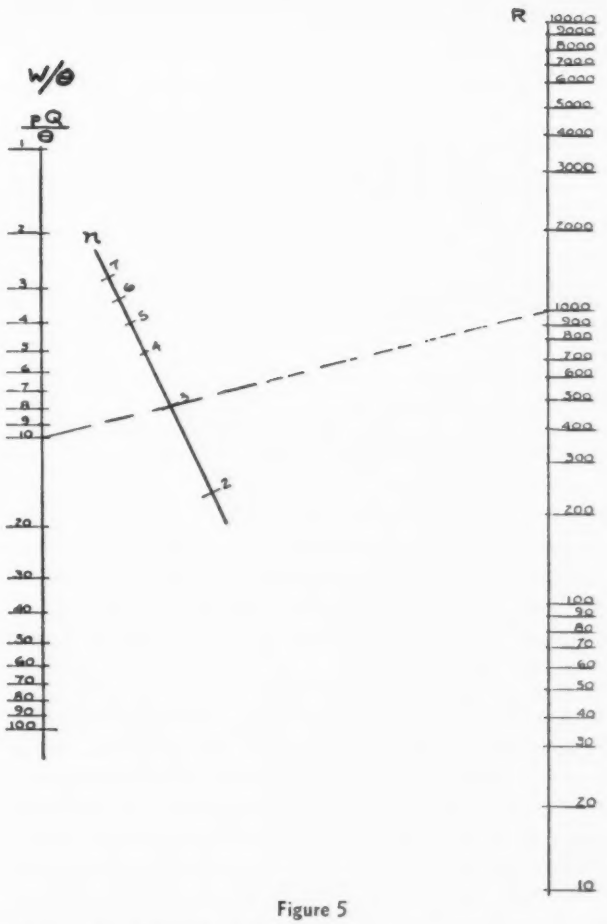

Figure 5

DESIGN OF RINSE TANKS:

In the past, little or no thought has been given to the design and construction of efficient rinse tanks, perhaps for the same reason outlined in the opening paragraph of this article. A discussion on the design of efficient rinse tanks is beyond the scope of this article. For further information on the subject, it is suggested that the reader consult references 1 and 2, of the appended list.

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A Survey of Chromate Treatments

By Walter E. Pocock, *Allied Research Products, Inc., Baltimore, Md.*

This is the second and final installment. Part I of this article appeared in our December, 1954 issue.—Ed.

Treatments for Zinc and Cadmium

The greatest variety of chromate treatments, and by far the largest number of proprietary products, are to be found in this group. Treatments are applied to electroplated zinc and cadmium, die cast zinc, and galvanized iron.

Let us consider first the effect of chromate films on plated metal. Zinc and cadmium, when plated over steel, protect against rust formation through sacrificial galvanic action. The plated layer, being electropositive to the steel, is corroded, while the steel is rendered passive. In this process, the plated metal tends to corrode faster than it would if it were not in contact with the steel. When a chromate film is applied, it serves a dual purpose. First, it retards initial corrosion of the plated layer. Eventually, the protective film will be broken through and the plate will begin to corrode. Even after this has started, however, the remaining chromate film continues to exert its inhibiting action, and thus retards eventual rusting of the base steel. In cases of other than plated metal there is, naturally, no such dual effect. Approximate protective values, as shown by salt spray, of the important types of chromate coatings for zinc plated steel, with respect to both white corrosion and red rusting are shown in Table I.[16]

Chromates are being practically applied to as little as 0.00002″ of zinc plate, although a minimum of 0.0002″ is desirable. Above this thickness, an apparent decrease in plate porosity greatly increases the effectiveness of the chromate treatment to prevent first signs of any corrosion. There is no top limit to plate thickness for chromating, but it has been observed that generally, where a chromate film is to be applied, additional plate beyond a thickness of about 0.0007″ is of little additional benefit corrosion-wise.

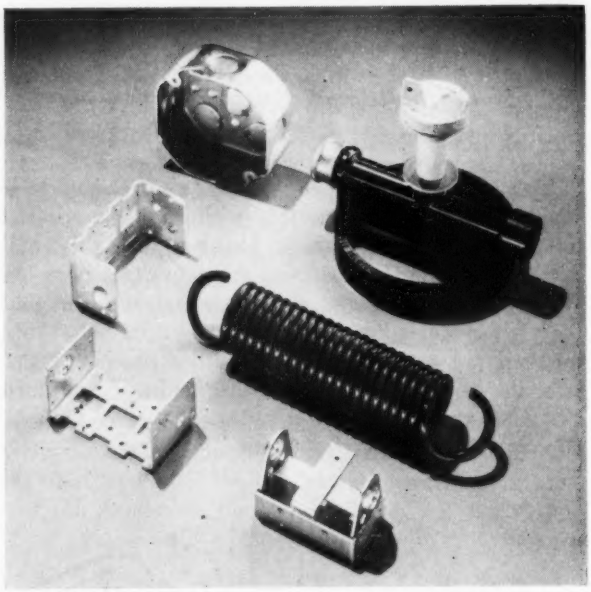
In chromating plated work, normally a negligible amount of metal is dissolved by the treatment. If, however, the work remains in prolonged contact with the solution, the film alternately "sloughs off" and reforms, and metal is continuously dissolved. The end result of this process is eventual complete stripping of the plate from the base metal. Excessive stripping is undesirable, of course, and is avoided where possible by holding immersion time to a reasonable minimum. When unusually long immersion times are necessitated by equipment limitations, it is usually possible to modify the chromate formulation to prevent undue stripping and still produce the desired results.

The texture of the plated deposit has an important bearing on the efficiency of the chromating operation. A smooth, fine-grained deposit takes less out of the solution than a coarse, porous deposit, and also gives a better looking coating. Heavy metal impurities, such as copper, in the plate can become harmful to the appearance and corrosion resistance of the chromate film. They should be held to a minimum in the plating bath.

The processing cycle, when chromating is to immediately follow plating, has already been outlined. Plated work that has been allowed to stand for some time does not take a chromate coating satisfactorily, because of oxide formation. In such cases the surface is reactivated by a dilute acid dip, such as ½% nitric acid. If a light oily film or other superficial soil has accumulated on the metal, it may have to be removed by alkaline cleaning before the acid dip.

Die castings are pretreated by, first, a conventional cleaning procedure such as is used preparatory to plating. This is followed by an acid dip, such as 1 or 2% sulfuric acid.

For galvanized iron, the following two pretreatments



Examples of chromate finishes on plated work. Spring (center) has been given olive drab treatment. Lower part of the assembly at upper right has been olive drab treated and dyed black. Remaining items have metallic bright finish.

have been found to be very effective where such is found necessary:

(1) Caustic soda, 3 ounces per gallon, at 160°F.

(2) 5% phosphoric acid plus 5% of a water-soluble organic solvent, at room temperature.

The great majority of treatments for zinc and cadmium are of the simple immersion type, operating within a temperature range of about 60° to 120°F. Treatment time is usually between about 5 seconds and 1 minute, although in a few cases is as high as 5 or 10 minutes. A wide range of coatings is obtainable, from solutions of varying basic composition, containing anywhere from about 1 to 70 grams per liter of hexavalent chromium, and covering a pH range of 0 or below to around 3.5. For the sake of simplicity, this group of treatments can be broken down into several general types.

BRIGHT TREATMENTS:

These are used where chemical polishing, as well as corrosion protection, is desired. Operating pH is in the low end of the range, from below 0 to usually not more than about 1.0. One type of formulation produces bright iridescent yellow coatings, which may be used without further treatment where a bright finish of maximum corrosion protection is desired, and the yellow color is acceptable. Usually, color is completely or partially removed in a bleach dip, which is nothing more than a leaching of soluble chromates, as previously discussed. As these soluble constituents are removed, corrosion resistance is lowered. The difference in salt spray life between colorless bright coatings and yellow coatings on zinc plate can be seen in Table I. Appearance after bleaching depends on the bleach used. Usually with caustic soda, a clear bright finish is obtained. If the yellow film is bleached in a warm sodium carbonate solution a red-green-blue iridescent finish results which is more protective than the clear bright coating. The subsequent application of a clear lacquer masks the iridescence, giving a clear metallic appearance and, in addition, improves wear resistance and gives some additional protection. This type of finish has been used to some extent as a substitute for chromium plate. Also, where such treated surfaces are not lacquered, but are small and broken, the resultant finish is a bright blue cast in color, resembling a natural chromium finish. In addition to caustic soda and sodium carbonate, other bleaches commonly used include dilute phosphoric acid and certain proprietary compounds. Hot water itself is a mild bleach. Besides the bright iridescent yellow coatings, bright colorless or nearly colorless coatings can also be produced in a single step, with somewhat modified formulations. Where a slight color is present, this can be removed by a mild chemical bleach, or by the bleaching action of a hot water rinse; or it can be masked by the application of a clear lacquer.

Up to the present time, bright treating of zinc and cadmium has applied mainly to the plated forms of these metals. Conventional bright chromate formulations have little or no chemical polishing action on die cast zinc or galvanize coatings. A common practice with die castings has been to zinc plate and then bright chromate treat. However, a new proprietary chromate solution has recently been released for sale which chemically polishes die cast zinc to a bright clear type finish which also provides excellent corrosion protection.

This new development may prove advantageous because of its unusual chemical polishing characteristics from two directions. First, its finish may prove sufficient on the zinc die casting directly without the need of the electroplating step. Second, it may reduce the need for mechanical finishing of the zinc die casting prior to subsequent electroplating.

YELLOW TO BRONZE TREATMENTS, NON-BRIGHTENING:

Treatments in this group, operating in a pH range of about 1 to 3.5, do little or no chemical polishing, but form heavier coatings, of a deeper color, than do the bright treatments. They are commonly applied to all forms of zinc and cadmium. Bleach dips are not generally used. The degree of iridescence obtained depends largely on the texture of the metal surface and on the size and shape of the treated article. Coatings on die cast zinc or dull zinc plate tend to be duller and less iridescent than on bright plate. Large flat surfaces show iridescence more than small, curved or broken surfaces. Hot rinsing promotes dullng of yellow to bronze coatings.

OLIVE DRAB TREATMENTS:

Applicable to all forms of zinc and cadmium, these produce the most protective of all chromate coatings for these two metals (Table I). They are also about the most abrasion resistant, when dried; like other chromate films, they are soft while still wet. As in the case of yellow and bronze coatings, hot rinsing tends to cause dulling. The chromate bath operates in a pH range of about 1.5 to 3.5. Coatings are heavier than those obtained with the yellow to bronze type treatments. The olive drab color, which is the natural color of the coating as formed, makes this type of treatment well suited for military applications.

COLORED COATINGS BY ONE OR TWO-DIP PROCESS:

The color of the olive drab and the heavier bronze coatings can be modified by immersion in a solution of any of certain organic dyes, acidified by small additions of glacial acetic acid. This is done while the film is still wet, i.e., while it is soft and absorptive; other-

Table I
Typical Salt Spray Data for Zinc Plated Steel[16]

		0.0003″ to 0.0007″ Plate Thickness								
	No Treatment	*Clear Bright or Bluish Bright*	*Yellow to Bronze*	*Electrolytic Yellow*	*Electrolytic Bleached*	*One-dip Black*	*Olive Drab*	*Electrolytic Black*	*Electrolytic Black, Sealed*
Hours to White Corrosion	< 8	24-100	100-200	100-200	50-100	24-100	100-500	50-100	100-200
Hours to Red Rust	150-400	250-750	250-1000				500-1500		

wise there is little or no color retention. Olive drab coatings can thus be modified to a jet black or dark shades of red, green, and blue. Bronze coatings have been successfully dyed in pastel shades of red, blue, green, orange, and violet. Depth and evenness of color, in the case of bronze coatings, appear to depend on thickness and uniformity of the coatings.

Not included in the above categories are the electrolytic treatments for zinc. Two variations of a proprietary chromate bath produce, respectively, a yellow and a black finish. A bright type finish can also be gotten from the yellow by bleaching. Certain advantages are claimed for the electrolytic over simple immersion treatments, including easier bath control, superior abrasion resistance of freshly formed coatings, and the use of ordinary steel rather than acid-resistant tanks. On the other hand, equipment requirements in general, and procedure are more complex than with the immersion treatments, and there appear to be limitations as to flexibility in the various finishes that can be obtained.

Operating pH range of the electrolytic treatments is somewhat higher than that of the simple immersion treatments. Procedure is similar to the zinc plating process itself and, as with any plating operation, involves the problem of current distribution. A comparison of operating conditions for the yellow and black treatments follows:

Color	*pH of Bath*	*Voltage*	*Current Density Range*	*Treating Time*
Yellow	5.5 to 6.0	1.5 to 4	5 to 50 a.s.f.	1 to 5 min.
Black	2.5 to 4.5	1.5 to 3	10 to 20 a.s.f.	2 to 10 min.

Treatments for Copper and Its Alloys

Mixtures of nitric and sulfuric, or of nitric, sulfuric, and hydrochloric acids, have been used for a long time for brightening cupreous metals. Chromate treatments are mainly improved bright dips, having three principal advantages over the older mixtures:

(1) Improved brightness
(2) Passivation of the metal surface (see Table II)
(3) Non-fuming solutions, eliminating the need for ventilation

Table II
Typical Salt Spray Data for Copper and Brass

	No Treatment	*Bright Coating*	*Heavy Coating*
COPPER - Hours to Green Corrosion	< 24	24	50
BRASS - Hours to Green Corrosion	< 24	100	150

Several proprietary treatments for cupreous metals are available. At least one of these will produce not only a bright finish, but also heavier, more protective coatings. Recent work has shown that even heavier and more protective films can be obtained and that these can be colored with organic dyes.

An interesting use of chromate bright dipping of copper is where chromium is to be plated directly over the copper. Chemical polishing reduces the need for mechanical buffing. The thin chromate film which is formed is removed chemically from the copper surface, leaving it bright and receptive to the chromium plate.

Treatments for Aluminum

Several proprietary treatments, similar in procedure and results obtained, are in use. Limits of operating conditions and bath characteristics are approximately as follows:

Temperature	60° to 130°F.
Treatment time	5 seconds to 8 minutes
Hexavalent chromium concentration	1 to 7 grams per liter
pH	1.2 to 2.2

Application is made by immersion, spraying, brushing, or swabbing. Coatings varying in appearance from clear to iridescent yellow or brown can be obtained from a single bath by varying the treatment time. Coatings build up slowly as compared to those on zinc or cadmium, with a gradual deepening of color. Excessive treatment time generally results in powdery and loosely-adhering coatings, or a partial sloughing off of the coating.

Chromates for aluminum have been very rapidly accepted since the first proprietary treatment was introduced about four years ago. Coatings are suitable as either corrosion-resistant final finishes, or as paint bases. In the aircraft and other industries, chromate treatments have replaced chromic and sulfuric acid anodizing to a large extent. Chromates generally give better corrosion protection than anodizing and are equally suitable for paint bonding, yet are far simpler to operate and require much shorter treating times. Because coatings are extremely thin, machined parts can be treated without concern for dimensional change. In the electronics field, chromates have the advantage of low electrical resistance over electrolytic oxide coatings. Other advantageous properties include weldability, self-healing of scratched areas, and ability to be cold formed without flaking off. As with most other chromate films, the principal disadvantage is low abrasion resistance. Where surfaces are anodized for wear resistance and then partially machined, a protective chromate film can be formed on the machined area by a simple brushing operation, if immersion treatment is not practical.

Proper pretreatment before chromating is particularly important with aluminum. A variety of pretreating methods are available. The choice in any particular case is determined by a number of factors, principally, the amount and type of surface contamination, dimensional tolerances, the alloy being treated, and availability of equipment. Metal finishing plants that are set up for anodizing can use already existing cleaning facilities, with, perhaps, slight modifications. As with other metals, oil, grease, and other lightly adhering soil must be removed. Vapor degreasing, solvent wiping, emulsion cleaning, or hot non-etch alkaline soak cleaning are all used for removing this type of contamination. Oxide removal is desirable for maximum uniformity and corrosion resistance of the chromate film. Proprietary chromate deoxidizers, such as are used preparatory to spot welding, have been found very effective for this purpose. These are acidic solutions

containing chromic acid or dichromates, which dissolve oxides but do not attack the metal. Where etching of the metal is permissible, oxides and surface soil can be removed in a single step by a hot alkaline etching solution. This is probably the most effective pretreatment method from the standpoint of complete removal of surface contaminants. Alkaline etching of certain alloys leaves a smut of alloying metals. If silicon, this is dissolved by a 3:1 nitric-hydrofluoric acid mixture. Otherwise it can be removed by nitric acid (40° Baumé, diluted 50-50 with water), or by a chromate deoxidizer.

The large variety of aluminum alloys in use makes for a considerable diversity in appearance of coatings obtained with a given set of operating conditions. Two different alloys treated simultaneously may show, respectively, a brown and a pale yellow coating. The greatest differences show up between high-silicon castings and low-silicon wrought products. Coatings on as-cast surfaces are generally much lighter in color than those on wrought alloys. Where the casting skin is removed by machining, sand blasting, or etching, a darker color is obtained. Non-uniformity in color between different alloys can be overcome to some extent by adjusting treatment times according to the type of alloy being treated.

Table III gives salt spray data for several typical aluminum alloys, before and after chromate treatment. As was said of chromates in general, protective value increases with film thickness, as indicated by color, for a given treatment. Color alone, however, is not a reliable indicator of protective value.

Table III

Typical Salt Spray Data for Aluminum

	No Treatment	*Clear Coating*	*Yellow or Brown Coating*
No. 2S Alloy (Commercially Pure) Hours to White Corrosion	24	60-120	250-800
No. 24ST Alloy (High Copper Content) Hours to White Corrosion	< 24	40-80	150-600
No. 13 Alloy (High Silicon Content) Hours to White Corrosion	< 8	12-40	50-250

Chromate formulations generally available at present do not chemically polish aluminum. Clear films can be applied to mechanically buffed surfaces to retard dulling and tarnishing. Clear films can also be advantageously applied to frosted finishes obtained by caustic etching.

Coatings produced by one particular proprietary treatment can be dyed by a procedure similar to that previously described for olive drab coatings on zinc and cadmium. Pastel shades of red, yellow, blue, green, and orange can be obtained on wrought alloys and machined surfaces of castings. Results are poor on as-cast surfaces. Depth and evenness of color depend on uniformity and thickness of the chromate film. The dyeing process does not materially affect corrosion resistance. Such dyed coatings can be used for color coding and other applications where light fastness and wear resistance are not required.

Treatments for Magnesium

Magnesium is the most active, chemically, and therefore the most readily corroded of the common industrial metals. It may be emphasized again in the case of magnesium that corrosion problems are serious only where there is exposure to moisture. Chromate treatments protect magnesium against corrosion and are suitable bases for protective and decorative organic finishes.

As with aluminum, a variety of alloys are in use, although the number is smaller. Here, again, results with chromate treating vary according to the alloy.

Pretreatment methods include solvent and alkaline cleaning to remove oil, grease and lightly adhering soil; and both mechanical cleaning and acid pickling to remove oxides and other contaminants. Strong alkaline cleaners do not appreciably attack the metal. A number of different pickling treatments are in use, serving a variety of purposes.[17] Straight chromic acid pickling dissolves oxide without attacking the metal. Various other pickles, for both wrought products and castings, remove up to 0.001″ of metal. This metal removal carries away surface contamination and helps to produce a chromate finish of maximum uniformity and corrosion resistance. With sand castings, sand or shot blasting has the effect of accelerating corrosion of the magnesium surface. This effect is overcome by removing about 0.002″ of metal in a sulfuric acid pickle.

Chromates as well as other surface treatments for magnesium have been developed and evaluated largely by the magnesium producers themselves.[18] The most widely used of these are fully described in the Metal Finishing Guidebook and, therefore, will not be repeated here.

Conclusion

Chromate treatments have become widely used not only because they fill a need for corrosion-resistant and paint-bonding finishes, but also because they are inexpensive and simple to apply. It has been attempted here to show how the basic features of the chromating process apply to a variety of treatments for a number of different metals.

The potentialities for further development are considerable. The bright chromating of die cast zinc is an important new step. Chromate treating of silver to prevent tarnishing has been tried with some success and is now on the market. Chromate treating of ferrous products is a fertile field for investigation. It is known that chromate films can be formed on ferrous metals, but so far these have not been developed to the point of practical usage.

It may be said, in summary, that chromates appear likely to continue to play a substantial part in the chemical finishing of metals.

Shop Problems

Abrasive Methods—Surface Treatments—Control
Electroplating—Cleaning—Pickling—Testing

METAL FINISHING publishes, each month, a portion of the inquiries answered as a service to subscribers. If any reader disagrees with the answers or knows of better or more information on the problem discussed, the information will be gratefully received and the sender's name will be kept confidential, if desired.

Immersion Brass on Steel

Question: Would you kindly give us some formulas or information whereby we may put immersion deposits of brass on steel.

K. H.

Answer: The following formula is not a true brass but a bronze, which is used as a liquor finish on steel wire:

Stannous sulfate — 0.25 - 0.75 oz./gal.
Copper sulfate — 0.1 - 0.3 "
Sulfuric acid — 1.25 - 4.0 "
Room temperature

Metal & Thermit Corp., 100 East 42nd St., New York 17, N. Y. has a pamphlet on this process, which is available on request.

Sand Bobbing

Question: What procedure shall I use for sand bobbing of holloware?

W. T. B.

Answer: Sand bobbing is usually performed on a walrus hide or bull-neck wheel using FF pumice, F emery or mixtures of the two with enough light machine oil to permit the paste to hold to the wheel.

Refinishing Pewter

Question: I would like to know about pewter and holloware. I have trouble getting the dark film from under the silver and would like to know what to do for it.

J. A. W.

Answer: When refinishing silver plated pewter, it is customary to pickle, after stripping the old silver, in a solution of about 25% muriatic acid. The pewter is then brushed with pumice and water or dried and buffed with greaseless compound to remove the skin.

Pipe & Fittings for Chromic Acid

Question: We are continually replacing valves, pipes and other fittings on our return line from our chromic acid reclamation tank. If you have knowledge of any new modern material available for this use which will stand up under chromic acid, will you kindly advise the writer at your early convenience.

F. R. S.

Answer: Since the temperature and concentration of the chromium reclaim solution are low, most plastics will be suitable for piping and fittings.

Blue Color on Steel

Question: I am writing to inquire whether or not you may have any material available as regards metal finishing on rifles and shot guns. This would concern bluing. I have used some commercially available salts in a hot-dip process with a resultant black finish. I would like to know if such a hot-dip process can be made to produce a bluer finish. The ingredients for this finish are sodium nitrate, sodium nitrite and sodium hydroxide.

H. R.

Answer: The process you are now using is known as a "caustic black" and all the proprietary products on the market will give you the same results, namely a black color.

The only blue color obtainable, which will stand up in use, is produced by carefully heating the steel. This produces a blue temper color, which can be protected by oiling or waxing. Since the dark blue color is produced at exactly 600 deg. F., care is required to avoid drawing the temper of the steel.

Copper Plate for Carburizing

Question: We have a plating problem involving the copper plating of crankshafts before carburizing. These crankshafts are made of Atlas Impacto, a carburizing steel similar to Atlas 4615. Can you suggest a plating procedure that would assure good adhesion of the copper plate? We are plating in a rochelle cyanide copper plating bath that is in good working order. Other shops in this area are having adhesion trouble with these crankshafts and we wish to avoid this problem when we take on the job.

What is the minimum copper plate required to protect against case hardening? What would be a fast, economical method of stripping the plate after carburizing?

W. J. M.

Answer: The steel of which the crankshafts are made contains 1.65-2.0% nickel. We would suggest that, after alkaline cleaning and acid dipping, a nickel chloride strike should be used for insuring adhesion prior to copper plating. The formula and operating conditions of the strike will be found in the METAL FINISHING GUIDEBOOK.

The copper deposit required will vary according to the depth of case to be applied. A minimum of 0.0005" of deposit is generally recommended for a 0.01" case. The copper deposit can be removed, after hardening, by a number of methods which will be found in the stripping section of the above-mentioned handbook.

Iron in Chromium Solutions

Question: I have been told that my chromium plating solution contains excess iron but the tank seems to be working as well as it ever did. What actually is the effect of iron in chromium solutions, and can it be removed when present in excess?

B. F.

Answer: The main effect of iron is to sequester chromic acid in the ratio of 1 part iron to 7 parts chromic acid. The reaction is as follows:

$$2Fe + 8CrO_3 = Fe_2(CrO_4)_3 + Cr_2(CrO_4)_3$$

Since the compounds formed, namely

ferric and chromic chromate, are not ionizable to any appreciable extent, free chromic acid is removed and the conductivity of the solution drops so that a higher voltage is required to obtain a given current density.

Removal of Silver from Gold Bath

Question: In attempting to convert our 40 gallon yellow gold solution to produce a light green shade we added what we later learned was an excessive amount of silver cyanide. Now, we are only able to get a white deposit which is completely unsuitable. Since the gold solution is fairly new and was made up with 20 ounces of 67% potassium gold cyanide, we would like to purify it ourselves rather than send it out for refining, which would involve an appreciable expense. Therefore, we are writing to inquire whether you can advise us of any practical method for removing the silver from the solution, or any other treatment or procedure which will permit us to use the present solution.

E. H.

Answer: The silver can be removed from the gold solution by plating out on a sheet of stainless steel. Since, at room temperature and 1½-2 volts, only silver will plate out while the gold remains in solution, this method should give satisfactory results. We would suggest that you dummy the solution overnight. On the following morning the temperature of the tank should be raised and a test panel or sample plated to determine whether the deposit is satisfactory or whether more dummying is required.

Brass Color on Steel

Question: There is a problem facing us, for which I am sure there is some answer. We are being forced to make steel items which must look like they are brass plated. I am told that brass plating is highly unpredictable and it is a rather elaborate process. Will you please give us the details of some other process, the results of which look like brass but which might be simpler.

I saw a process done of plating the articles with zinc then dipping them in a dilute solution of nitric acid then into a solution which gave the zinc a brassy color. I did not think the result was bright enough.

D. M. W.

Answer: Brass plating is not an elaborate process. In fact, it would be much simpler and results would be more consistent than zinc plating, bright dipping and chromating. For the solution and operating procedure, we would refer you to the section on brass plating in the METAL FINISHING Guidebook.

Softening Water

Question: Our plater informs us that a chemist suggested he add lime to our water supply, which has a very large calcium hardness, claiming that this would soften the water and make it usable for process purposes. It seems ridiculous to add more calcium to the water to remove calcium but our plater says the chemist is correct. We would like to have your opinion as to the validy of this recommendation.

E. T. M.

Answer: The chemist is correct. Calcium hardness in water is present as the soluble *bicarbonate*. When lime is added to such water, insoluble calcium *carbonate* is formed, accordto the following equation:

$$Ca(HCO_3)_2 + CaO = CaCO_3 + H_2O$$

However, it is important to avoid addition of any excess of lime, which would remain in solution as new hardness. Because of this factor, it would be more practicable to employ a zeolite type softener or an ion exchanger.

Recently Granted Patents
in the Metal Finishing Field

Patents

Periodic Reverse Plating

U. S. Patent 2,678,909. *May* 18, 1954. *G. W. Jernstedt and J. D. Patrick, assignors to Westinghouse Electric Corp.*

In the process of electroplating on an electrically conducting member a metal from the group consisting of copper, silver, zinc, cadmium, tin, gold and brass, from an electroplating electrolyte thereof, the surface of the member being plated having a roughness of about from 13 to 17 microinches R.M.S., the steps comprising placing the member and an anode in contact with the electrolyte and passing in series through the member, the electrolyte and the anode a plurality of cycles of periodically reversed current, each cycle consisting of essentially, first, a plating electrical current for a period of time of at least 45 seconds to plate metal from the electrolyte on the member and, second, a deplating electrical curent for a period of time of at least 30% of the plating period, the average deplating current density on the member being from 50% to 90% of the average plating current density, and the coulombs delivered by the deplating current being between 30% and 95% of the coulombs delivered during the plating portion of the cycle whereby a substantial portion of the previously plated metal is deplated, and causing a relative movement of the electrolyte and the member relative to one another at a rate of at least one foot a minute, the applied plurality of cycles of periodically reversed current producing a deposit of plated metal of a roughness of at least 25% less rough than the surface of the member for a 0.001 inch of metal plated, the plated metal being of a closely uniform thickness over the entire surface plated.

Coloring Metals Black

U. S. Patent 2,679,475. *May* 25, 1954. *J. C. Singler.*

A process of blackening a metal surface from the class consisting of steel, brass, copper, aluminum, nickel and cadmium comprising immersing the metal surface in a water about 8 oz. nickel chloride; about 4 oz. of ammonium chloride; about 1 oz. of Rochelle salt; about ¾ oz. of zinc chloride; about 2 oz. of sodium chloride; and about ¼ oz. of ammonium molybdate, and passing a low voltage electrical current therethrough with the metal as the cathode.

Bright Cyanide Zinc Bath

U. S. Patent 2,680,712. *June* 8, 1954. *M. B. Diggin and O. Kardos, assignors to Hanson-Van Winkle-Munning Co.*

An aqueous alkaline cyanide zinc plating bath containing, in amounts of substantially 2.5 to 9.5 g./liter, as a brightening agent a condensation polymer of an aliphatic alkylene-polyamine with furfural-sodium bisulphite and formaldehyde, 0 to 50% of the latter in the form of its sodium bisulphite compounds.

Rust Inhibiting Composition

U. S. Patent 2,680,718. *June* 8, 1954. *L. T. Eby, assignor to Standard Oil Development Co.*

A composition consisting essentially of a hydrocarbon solvent containing dissolved therein 0.01 to 10% of a monoester of a C_{12} to C_{24} unsaturated fatty acid with a polyhydroxy aliphatic compound containing 5 to 6 carbon atoms and having 4 to 6 hydroxyl groups attached to carbon atoms separated from each other by not more than one carbon atom containing no hydroxyl group, which monoester has been sulfurized by a reaction with elementary sulfur.

Scale Removal from Sheets

U. S. Patent 2,680,938. *June* 15, 1954. *R. O. Peterson, assignor to The Osborn Mfg. Co.*

In apparatus for removing scale from metal sheets, the combination of a revoluble roll, a rotary brush mounted opposite said roll on an axis parallel to the axis thereof, and means for progressively flexing a metal sheet with the concave surface thereof engaging said roll and the corresponding convex surface engaging said brush, said means including bending rolls located on opposite sides of said first-named roll and disposed arcuately to bend such strip to a curve of greater diameter than the diameter of said first-named roll.

Work Transfer Device

U. S. Patent 2,681,015. *June* 15, 1954. *J. V. Davis, assignor to The Udylite Corp.*

A work transfer mechanism comprising a track system, a bar along the track of said system and spaced therefrom, a carriage movable on the track of said system, said carriage having a hook-engaging portion pivotally suspended therefrom and movable toward and away from said bar, a hook having two hook elements, one of said elements for engagement with and disengagement from said portion and the other for engagement with and disengagement from said bar, means forming part of said track system for swinging said portion adapted in one position along the track to drop said other element on said bar and in another position to remove said other element from said bar.

Buffing Compound

U. S. Patent 2,681,274. *June* 15, 1954. *C. B. F. Young.*

A buffing compound for polishing the surface of an article to be further treated after the buffing operation by the removal of the water-dispersible film residue of which is adapted to be readily removed by an aqueous liquid after the completion of the buffing operation which comprises an abrasive material containing constituents of the group consisting of sodium carbonate, sodium bicarbonate, calcium carbonate, and a mixture of aluminum sulphate and a metal carbonate for the development of a film dispersing gas in con-

tact with water acidulated with an acid of the group consisting of sulphuric acid, hydrochloric acid and tartaric acid and a vehicle therefor containing polyethylene glycol stearate and stearic acid.

Rust Preventive Oil Composition

U. S. Patent 2,680,094. *June* 1, 1954. *J. H. Bartlett, A. D. Kirshenbaum, and H. W. Rudel, assignors to Standard Oil Development Co.*

A rust inhibiting composition consisting essentially of 95 to 99.9% by weight of mineral base lubricating oil, 0.05 to 4.5% oil-soluble metal base petroleum sulfonate, and 0.005 to 1% of aliphatic alcohol esters of ethylene bis-imino diacetic acid having at least 8 and not more than about 18 carbon atoms in each alcohol group.

Diffusion Coating

U. S. Patent 2,681,869. *June* 22, 1954. *W. C. Johnson, assignor to The Duriron Co., Inc.*

The process of surface-modifying a metal article by the action of an impregnating or alloying metal, which comprises providing the article initially dry, adherent coating comprising an unsintered mixture of finely divided slag-forming solid mineral materials associated with an agglutinant binder that renders the mixture coherent, said mixture including a source of the impregnating metal, silica and a metal halide, so proportioned as to facilitate sintering of the mixture at suitably elevated temperature non-destructive to said article and promote action of the impregnating metal upon the underlying or basis metal surface; then heating the coated article to a temperature not lower than about 1,550°F. that is high enough to sinter or partially fuse the coating mixture to viscous consistency and thereby substantially seal the underlying surface of said article, but is insufficiently high to render the coating mixture thinly fluid or to endanger the integrity of said article; continuing the heating within such temperature range until the desired impregnation has been effected; then cooling the article and removing therefrom any sintered coating mixture adhering thereto.

Coloring Aluminum Black

U. S. Patent 2,681,873. *June* 22, 1954. *G. L. Deniston.*

The method of producing an oxide coating on aluminum and alloys thereof, which comprise immersing the aluminum objects in an aqueous acid solution maintained at a temperature in the range between about 68 degrees Fahrenheit and about 220 degrees Fahrenheit for a period of about 30 seconds to about 3 minutes and containing as its essential active coating ingredients about 1.2% to about 2.2% of water soluble sodium salts of alkyl aryl sulfonates and sulfate ions, chromate ions, chloride ions, and manganese ions in quantities produced in acid solution by about 9.4% to about 22.4% of sulphuric acid, 26.0% to about 30.6% of sodium chromate, about 14.8% to about 34.6% of hydrochloric acid and 26.5% to about 30.6% of potassium permanganate, the total of said ingredients being in quantities ranging from about 42 parts to about 70 parts by weight of solids to about 400 parts of water.

Oxidation Prevention

U. S. Patent 2,682,101. *June* 29, 1954. *M. G. Whitfield and V. Sheshunoff, assignors to Whitfield & Sheshunoff.*

The method of protecting metal bodies chosen from the class consisting of tungsten, molybdenum, alloys of tungsten and molybdenum, and alloys containing at least 15% of any of the foregoing, against surface deterioration at elevated temperatures which comprises electrodepositing a thin coating of nickel on the surface of

said bodies, heat treating said coated bodies under non-oxidizing conditions to cause at least partial diffusion of said nickel coating, and immersing the bodies thus treated in a bath of molten aluminum to form an aluminum-rich protective layer thereon.

As a new article of manufacture, a refractory metal body protected from surface deterioration at elevated operating temperatures comprising a core constituted of a refractory metal selected from the group consisting of tungsten, molybdenum, alloys of tungsten and molybdenum, and alloys containing at least 15% of any of the foregoing with at least one of the metals iron, nickel and cobalt, and a protective layer on said core essentially composed of an alloy of aluminum with the material of said core.

Sealing Anodized Aluminum

U. S. Patent 2,681,310. *June* 15, 1954. *W. H. Wood, assignor to Harris-Seybold Co.*

A process of treating an aluminum surface, which comprises subjecting the aluminum surface connected as an anode to electrolytic anodic treatment in aqueous acid solution providing oxygen at the anode, and then subjecting the so-treated surface to polyacrylic acid in aqueous medium at a raised temperature not substantially above 100°C.

Electroforming

U. S. Patent 2,682,501. *June* 29, 1954. *G. K. Teal, assignor to Bell Telephone Laboratories, Inc.*

The method of forming a two-sided target which comprises the steps of mounting an apertured metallic screen on a metal support, insulating the exposed surfaces of said screen, removing said metal support thereby exposing one side of said screen, coating said exposed side with non-metallic material which is non-conductive and insoluble in electroplating solution, coating a thin film of metallic material upon said insulated surface of said target, applying a protective coating of said non-metallic material on to said metallic film in such a manner that the portions of said metal film in the apertures are exposed, electroplating in said apertures until metal plugs are formed having heads protruding from both sides of the screen which are larger than the diameter of each aperture at its narrowest point, and removing said protective coatings of non-metallic material and said thin film of metal from the sides of said screen.

Abrasive Belt

U. S. Patent 2,682,733. *July* 6, 1954. *O. S. Buckner, assignor to Bay State Abrasive Products Co.*

A flexible abrasive band comprising an endless flexible backing and a porous abrasive layer attached to the outer face thereof, said backing being formed of a plurality of side by side, overlapping convolutions of flexible textile tape and having a plurality of unmatted stitch loops attached thereto and projecting from the outer face thereof, said abrasive layer encasing said loops and providing a relatively thick, continuous, substantially smooth, abrasive surface across substantially the whole width of said band without interruption at the overlapping edges of said convolutions.

Brush

U. S. Patent 2,682,734. *July* 6, 1954. *R. O. Peterson, assignor to The Osborn Mfg. Co.*

A brush comprising a base and flexible bristle material extending therefrom, such bristles comprising an elongated filamentous strand of low damping capacity wire having a Knoop hardness of at least 600, an outer coating of nylon on said wire, and fine abrasive and powdered filler material incorporated in said nylon.

ABSTRACTS

Influence of an Alternating Current Component on the Current Distribution in Galvanic Electrolytes

J. Steiner: *Zeit. fuer Phys. Chem.* Vol. 201, p. 161.

An investigation was undertaken on some electrolytes regarding the influence of an alternating current component superimposed on the direct current. The work served to show that from the cathode stream oscillogram of the alternating voltage component of the cathodic polarization, very far reaching conclusions could be drawn on the effect of the alternating current component.

Determination of Zinc and Tin Coatings on Steel with Hydrochloric Acid Containing Trivalent Antimony Chloride

G. Schikorr: *Metall.* Vol. 7, p. 337.

In order to avoid errors arising from attack on the base metal the author recommends a) in the determination of zinc coatings to confine the solution action to 30 seconds: b) in the determination of tin coatings, instead of the antimony-hydrochloric acid normally used in Germany, use the solution which is mostly used for its preparation. Instead of this a highly concentrated sodium polysulfide solution can also be used.

The Bend Properties of Zinc Coatings

H. Bablik and F. Goetzl: *Metall.* Vol. 7, p. 313.

The two dominant factors involved in deformation during working are, first, the extent of the adhesion and, secondly, the extent of the deformation which again is determined by the orientation. Of further importance are the temperature and rapidity of the deformation and to what extent any stresses formed during the coating process remain permanent. Observation of the test results have rendered it possible not only to obtain coatings which resist deformation better and in a satisfactory manner but also to work them to a greater extent than formerly.

Metal Cleaning with Emulsions

A. Pollack: *Chemiker Zeitung.* Vol. 76, pp. 141-142.

Highly diluted aqueous emulsions of high boiling organic solvents, such as petroleum, commercial benzol, etc., are practically neutral metal cleaning agents. The base emulsion of 50 to 60% is diluted 50 to 60 times for application and, at first, it was possible to use it only in a spray cleaning unit. If emulsions with a soap-like emulsifier are used, then the water need only be softened by phosphate. Non-ionizing emulsifiers are less sensitive to hard water and acids and can, accordingly, also be used with the addition of phosphoric acid for the purposes of passivation. Light, soft and colored metals are not attacked by emulsion cleaners.

Degreasing Layouts for Aluminum Treatment for Light Metal Semi-Products

O. Weiler: *Aluminium* (Germany.) Vol. 28, pp. 441/442.

The author describes the layout of a modern pressworks in which the degreasing is conducted with perchlorethylene and aluminum containers are used. In the main, the wash vessels and the assembly vessels as regards their arrangement, conform to normal practice. The grease-loaded solvent solution is passed to a distillation vat from which the vapors pass directly to a cooling vessel and they are here condensed and passed back for a further degreasing cycle. The solvent is heated to 75°C. by an electric current in order to speed up the degreasing effect. It is stated that good operating results have been obtained with this process.

Developments in Phosphating Techniques

A. Pollack: *Rhein. Westf. Ind. Markt.* Vol. 4, No. 8/9, p. 5.

The known processes of phosphating are being steadily developed. Thin, adherent, elastic coatings with a high degree of protection are being produced. Recent developments have been in the direction of coupling the production of these thin coatings with the degreasing and pickling stages. Acid phosphates with a low pH value (4.5) have been most recently introduced for degreasing the steel sheet as delivered, containing fat solvents and emulsifying agents. The process is most generally operated in spray pickling plants. The treatment time is 1-5 minutes. In addition to the degreasing action, coatings of complex ferri-ferrophosphates are obtained. The weight of the coating amounts to about 0.25 to 1.0 g./sq. m. With this process only light rust can be removed and heavy rusting or oxidation must be removed by prepickling. Processes have been developed for providing a passivation effect by which still thinner coatings of only 0.5 microns are produced. The baths for this process are strongly acid (pH 2-3) with the addition of inhibitors with fat solvent as well as wetting agent. The process gives good rust protection with a lacquer coating.

Chemical Protective Treatment for Tinplate Sheet

E. S. Hedges: *Metaux.* Vol. 28, No. 332, pp. 171-174.

Although the very thin tin coating on tinplate is resistant to corrosion, because of the fine porosity the protection it affords against the requirements imposed on tinplate containers is only of limited extent. This becomes particularly obvious in the food packing industry when the contents consist of meat, fruit and certain types of vegetables. During the sterilization process sulfur is set free from the packed substances and this attacks the tin coating in the interior of the cans and colors the metal blue. Although this coloration is harmless it invokes mistrust when the user sees it.

When conducting research on the protection of tinplate by chemical treatment one started from the basis of the electrochemical treatment of aluminum. The work began in 1938. It had been experimentally established that tinplate was made more resistant to the attack of sulfur by means of electrochemically produced oxide coatings. The first research covered the use of ammonia solutions or ammonium carbonate solutions or mixtures of these as the electrolyte. In other tests, sodium aluminate solutions were used. Although it was possible to work rapidly and well with this process it did not prove commercial because of the expensive equipment required.

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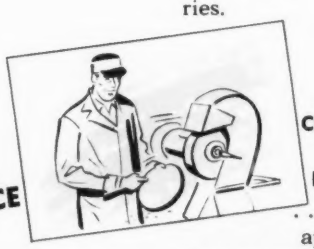

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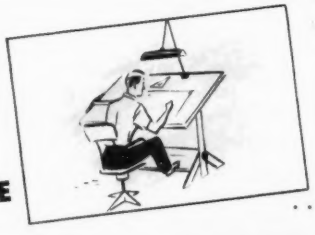

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9-H COBALT-NICKEL—A time-tested bright nickel process not dependent on organic addition agents for highly brilliant deposits. Properly installed, it is outstandingly stable, producing deposits with good physical properties and unsurpassed protective value.

NICKEL **(Sulfamate)**—A sulfamate salt process for producing heavy, smooth deposits with superb physical properties. Bath developed especially for build-up of nickel deposits of several thousandths and more. Ideal for electroforming and electrotyping operations.

BLACK NICKEL No. 1—A prepared salt mixture for producing a decorative gray-black gunmetal finish.

BLACK NICKEL No. 3—Produces a deep-black decorative finish on copper, brass and nickel-plated steel. Also for obtaining black background on brass or aluminum name plates. Used for immersion black on zinc die-castings or zinc-plated parts.

BBZ-201—For bright zinc plating in barrels. Produces zinc deposits ranging from silvery-bright to a brilliant bluish-white appearance directly from the bath. Bright dipping is optional.

BSZ-300—An economical, high current-density process producing brilliant zinc deposits from still tanks and conveyors. Deposits readily accept conversion coatings.

CADUX HS—Produces brilliant, pure cadmium deposits at high plating rates in still tanks, conveyors and mechanical cylinders. A bath highly stable and tolerant to impurities.

WES-X COPPER—Smooth, brilliant deposits free from co-deposited organic brighteners. Exceptional corrosion protection, good physical properties and marked leveling when periodic reverse current is employed.

SILVER-LUME—The process that has changed long-standing concepts of silver plating. Produces brilliant and mirror-like silver deposits direct from the plating solution, satisfactory in many cases without subsequent buffing.

Bath has exceptional throwing power. Deposits are hard and wear-resistant, with high protective value, and are somewhat more resistant to tarnish than ordinary silver deposits.

S-B ZINC—An all-purpose zinc bath producing satin-bright to full bright deposits (depending upon solution composition and operating conditions). Has remarkable throwing power and high surface activity for subsequent surface conversion coatings.

SUPER-PROTECTO LEAD PLATING—For applying heavy lead deposits at moderately high current densities in still tanks, barrels and automatic equipment. Furnished in the form of a liquid concentrate.

ALBALOY PLATING **(Bright Alloy)**—Ternary alloy deposits (approx. 55% copper, 30% tin and 15% zinc). Deposits are silvery-white and bright, have high tarnish resistance, have excellent corrosion protection properties, are highly reflective (85% of silver), are relatively hard (Rockwell 50C) and are easily soldered. Melting point is approximately 950°F.

Recommended on copper or copper-bearing nonferrous materials. On electrical instrument parts, because of high tarnish resistance, has ease of soldering and corrosion-protective qualities. Non-magnetic and abrasion resistant. Useful at ultra-high frequencies because of combination of properties. Used as a protective and decorative coating on beryllium copper springs.

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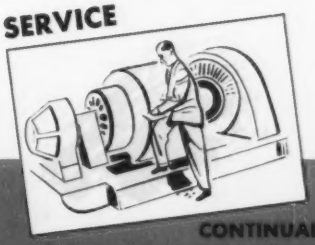

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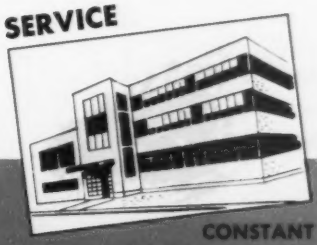

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by which the tinplate after degreasing was dipped in a warm chromate or sodium phosphate solution and covered with an invisible oxide film. By the use of wetting agents it was possible to shorten the treatment time to 30 seconds so that the process could be used in practical production. The newest process worked out by Britton has the object of further shortening the treatment time as, with a 30 seconds dip time, the process cannot be installed in the continuous tinplate processing lines. The process consists in passing the tin coated strip as it leaves the electrotinning line bath through a bath containing 1% caustic soda and 0.3% sodium bichromate plus a wetting agent. The treatment time is only 3 seconds. The process has been given the name of Protectatin. Practical corrosion tests have shown that cans so treated did not oxidize internally and, on storage in a damp atmosphere, did not rust on the outside. The first test results as regards lacquer adhesion on surfaces so treated appear to show that the lacquer adheres very well. Special tests are necessary however, for each type of lacquer. It can be anticipated that the process will be rapidly introduced into practice.

Comparison Between Hot Dip Tin and Electroplated Tin Sheets

W. R. Lewis: *Metaux*. Vol. 28, No. 332, pp. 175-183.

In hot dip tinning a part of the tin is alloyed with the steel surface. The surface is brilliant when the sheet leaves the dip bath and, after exit from the melt, is passed through a palm oil bath by which the unavoidable pores in the tin coating are then covered. With electrotinning no alloy formation initially occurs between the tin coating and the sheet surface. By conducting the tinned sheet strip through electrically heated equipment the matt plated tin surface is melted for a short time, alloys in a thin zone with the iron base surface and assumes brilliancy. The pores in the tin coating become partly closed but with this process cannot be entirely avoided either. Accordingly, the tinplate strip is treated for a short time by passing through a chromic acid bath so that the iron at the base of the pore is protected by a thin coating of oxide. The final treatment consists of a short oiling.

With regard to the corrosion resistance it can be said that tin coatings applied by electroplating should be not less than 1.5 microns thick. The tin coatings of 0.8 microns and even 0.4 microns thickness which were applied during the war are only usable for certain applications. With hot dip tinned sheets the coating thickness amounts to at least double that of electroplated tinsheet.

Tinplate is very suitable for forming operations — drawing and stamping etc). The tin coating and the thin oil film on the surface favor deep drawing. Tinplate is particularly suitable for soldering operations. In so far as soldering faults do occur, these can most often be ascribed to the sheet. Normalized sheets are less suitable than sheets which have had a stress relieving heat treatment.

As regards the adhesion of lacquer and paint coatings to tin coated sheets, the same circumstances hold for both types of tinning. In many cases two lacquer coatings must be applied as the lacquer coatings themselves also are not pore-free. This holds particularly for food containers made from tinplate in which strongly corrosive foodstuffs are packed. For such cases it is preferable to apply tin coatings which are thicker than 1.5 microns. It is possible to produce this by electroplating but sufficient equipment layout for this purpose is not yet available. Many American technicians are of the opinion that certain tinplate food can packs with a 0.4 or 0.8 micron tin coating often behave in practice just as well as tinplate with a 1.5 or 2 micron thick coating. This is accounted for by the fact that the sheets have outstanding surface characteristics and so accordingly denser tin coatings are achieved.

The pretreatment is of extreme importance in determining the quality of the subsequent electroplated tin coating. The heat treatment of the sheet and strip for example, is fo the greatest influence on the surface quality of the steel. The heat treatment atmosphere and the pickling treatment play a great role of significant importance in this direction. Great value must also be attached to the chemical composition of the steel.

The task of improving the quality of the steel strip is not simple. Cold rolled strip is better than the pack rolled sheet. This has allowed the hot tin coating to be reduced from 2.4 and 2.2 down to 2.0 microns. For a satisfactory service performance the storage of the tin can packs is also important. Rusting of the cans is prevented, if they are stored in a dry room at a uniform temperature. The atmosphere in the finishing workshops is also of importance. Electroplated tin sheet is cheaper than is hot dip tinned sheet.

Impregnation of Steel Surfaces with Molybdenum from the Gaseous Phase

G. N. Dubinin: *DoKlade Akademii Nauk USSR*. Vol. 84, pp. 935-938.

The author investigated the diffusion of molybdenum from the gaseous phase — gaseous molybdenum chloride — into the surface of steel test pieces with 0.03 to 1.2% carbon at temperatures of 900 1.300°C. and compared the diffusion velocity with that of tungsten. Through the absorption of molybdenum, the heat and corrosion characteristics of the steel surface are changed.

The Protecta Tin Process

Metallwaren Industrie und Galvanotechnik. Vol. 44, No. 5/6, pp. 185-187.

The study covers the protection of tinplate and articles made from tinplate such as food cans. The articles to be treated and protected are dipped in a bath consisting of:

Sodium Dichromate	3	g./l.
Sodium Hydroxide	10	"
Wetting Agent	2	"

The dip is for 30 seconds at 85°C. The bath should not boil. This is followed by a rinse in hot water, drying and a repeated rinsing in clean, hot water and drying in warm air. To control the effectiveness of the protective coating formed, a test plate is dipped for one minute in a solution of 1% sodium hydroxide and 1% liver of sulfur (potassium polysulfide). With this dip, no streaks should be formed on the test plate. The bath must be controlled in operation and the free sodium hydroxide and bichromate contents are determined. The determination of the free caustic soda content is conducted by titration with N/4 hydrochloric acid with the addition of barium chloride and thymolphthalein as an indicator. The determination of the dichromate is conducted by titra-

tion with N/10 sodium thiosulfate solution after the addition of water, hydrochloric acid and potassium iodide.

The following papers were read at the *Hard Chromium Plating* Conference held in Paris on May 1953 and on Chromium Plating at Melbourne.

The Adhesion of Hard Chromium Deposits

By *Borde* and *Mercier*

The authors had conducted the following basic experiment. If a cylindrical test rod with a thick chromium coating is subjected to a tensile test with a slow progressive increase in the loading, then it is observed that the chromium develops circular cracks. These cracks form sections on the test rod. Further, it can be observed that the number of these cracks under an almost constant loading increases, by which the cracks form uniform rings. These loosen away spontaneously according to the degree of adhesion of the chromium to the steel, the net result being that in only a few cases do traces of chromium remain at the crack locations. This observation is interesting with regard to the fact that the rings do not continue to subdivide themselves indefinitely, but they spontaneously break away from the test rod when their width falls below a certain value, which the experimenters were able to bring into direct relation to the adhesion. A mathematical theory of this phenomenon was developed and the conclusions arrived at by means of this theory were confirmed by experiment. Borde and Mercier then worked out a method by which with a proportionality coefficient, the ratio adhesion/load of the chromium deposit could be calculated.

With the use of this method a scale of adhesion values could be determined in the range of strongly adherent deposits to the base metal in which the duration and nature of the anodic treatment varied with various test rods. Research was also undertaken by the authors to prove that the geometrical condition of the base steel surface exerted no great influence; this appeared to confirm the assumption that the chromium to steel bonding is a microscopic function corresponding to the dimensions of the chromium and steel crystal lattice respectively in which the

geometrical disturbances play no role.

Although this method apparently can only be applied with difficulty outside the laboratory, nevertheless it does provide a new research tool, because in the field of the strongly adherent electrodeposits which are produced in industry it provides the research worker with a simple, easy means for the determination of a series of adhesion values.

Use of Hard Chromium Plating in Hydraulic Engineering

By *Kermabon*

The author discussed some specialized applications of hard chromium plating in hydraulic engineering practice. Information was given on some results which have already been obtained with the chromium plating of Francis water turbine labyrinths. These results showed that considerable improvements had been obtained. While the usual steel parts formerly were only capable of operation during a period of use during which the play could rise to 200 to 300% of the initial play, the chromium plated labyrinths now in use were now able to remain in operation for at least two of these periods of use and during which the rise in the play did not exceed more than 30%.

At the moment long-term comparative tests are in progress with chromium deposits of varying thicknesses. Further tests have also been started for the purpose of determining the most suitable material which, under the conditions ruling in hydraulic engineering practice, could serve to work with hard chromium without danger of seizure.

The author then proceeded to explain with the aid of some well chosen examples, as to what wear problems need to be solved in the operation of hydraulic water turbines for electric power generation; he also explained how the application of hard chromium plating would appear to provide a profitable solution and the value of this could only be ascertained directly from practical experience in its application.

The Strength of Hard Chromium Plated Steels

By *Morisset*

In this paper the author spoke with the greatest possible objectivity. In the

form of diagrams which gave a coherent presentation the author assembled the results which have been obtained both in France and in foreign countries with regard to static tensile, bend, impact tests etc.; further as regards fatigue with alternating loading and with the consideration of the various parameters involved—nature of the base metal, surface pretreatment, electroplating conditions, plated coating thickness, heat treatment. Although most of the results in many cases scarcely agree it is nevertheless possible to form an approximate idea regarding the nature and amplitude of the phenomena.

With the static tensile, bend, impact tests etc., it is established that the chromium plating leaves the strength of the steel practically unchanged and the breaking load and yield point after the chromium plating reach the same values. The plastic deformation of the chromium-steel composite is, however, reduced by the chromium plating. With an experimental heat treatment lasting for 2 hours at 200°C. the initial plastic deformation was partially or completely restored.

With the vibration and bend tests with alternating load the results differed markedly from one another but, nevertheless, the following general tendencies could be observed. It was established that the fatigue strength limit of the base steel is reduced all the more by the chromium plating the higher is the initial hardness of the steel. Apparently the following factors play a dominant role: the nature of the base steel and after this the anodic pickling effect; further the structure of the deposit and, accordingly, the electroplating conditions. However, at present very little is known about these influences. A grinding conducted after the chromium plating appeared to improve the fatigue strength. With a plating thickness below 0.05 mm. in general the fatigue strength is influenced by the chromium plating and this is independent of whether or not the part is subjected to a heat treatment after the chromium plating. With a plating thickness over 0.1 mm. a heat treatment at 200°C. can reduce the fatigue strength to a considerable extent. With the very high temperatures of 400° to 500°C. the initial fatigue strength was again restored.

At the end of his paper the author warned against a too hasty extrapolation of results obtained with test rods on fracture phenomena, as is employed in industrial testing practice as here other factors also intervene. In this respect some examples were given of fracture phenomena observed in industry which can be profitably solved by simple processes.

Applications of Hard Chromium Plating in the Tile Making and Terra-Cotta Industries

By *Gillet*

The author used the viewpoint of the practical man concerned with production and details were given of the most important applications of hard chromium plating for the following parts in the clayworking industries:

Materials: Mixing arm blades, feeding worms, molds, dies, mouthpieces which are used for preparing and shaping the clay mixture being worked.

Apparatus: Pugmills and mixing machines and mills in which the mass is prepared for shaping.

Pressing Machinery: Screws, presses, extruding cylinders which press the mass through the above-mentioned apparatus and parts.

General machinery which is not exclusive to the clayworking industry: pumps, presses, etc.

An impressive application study was presented in this paper to industrialists on the great application possibilities of hard chromium plating in the vast clayworking industry and the useful results obtained in practice are

continually being strengthened by further experience.

Classical Working Procedures for Hard Chromium Plating

By *de Buyer*

As a classical example of hard chromium plating application in the engineering industry the author chose the dimensional restoration of a worn bearing seating on an aero engine crankshaft and the various stages of the work: control, testing dimension, determination of the minimum deposit thickness, degreasing, mounting, sealing, and stopping-off processes respectively, special anode arrangement, electrolytic cleaning, electrolytic pickling, chromium plating, rinsing, testing of the dimensions etc. For the hard chromium plating of a simple part more than 15 follow-on stages are necessary.

The author then gave details of the application of hard chromium plating to various parts in engineering practice: Borers for the working of aluminum and synthetic resins; rams of hydraulic damping out suspension systems for wagons; machine tools; pistons on Constellation aircraft; printing rolls for textiles; model platen for medal coining presses; rings for spindle ends; Thread spinning guides; water meter nozzles; pistons for LKW hydraulic brakes; Friction plates for the production of artificial fibers; screws for plastic presses; aero engine exhaust valves; mantles covers which are placed over a light metal propeller nose; crankshafts; piston rings with auto-lubricant surfaces for aero and diesel road vehicle engines; dies for drying steel tubes with self-lubricating chromium plating.

Cold Chromium Plating Without Nickel Undercoat

Cold chromium plating has now been propagated by various firms for some two decades but has not yet been practiced to any extent in Australia. The actual advantages of cold chromium plating baths are lower installation costs and lower operating costs because of the dispensation with the heating system. The current efficiency of the cold baths is also higher and the throwing power better but the current density range within which bright deposits can be obtained is narrower. Attempts have been made to improve these cold baths by making various additions and also the fluoride-containing baths would appear to be better suited for cold chrome plating. These baths however, show disadvantages which more than outweigh the not very great economies achieved by dispensing with the heating system so that the cold chromium plating processes have only been applied provisionally in relatively small operations in a few small works where the initial installation costs are more significant.

Direct Chroming Without Nickel Undercoat

Direct chromium plating without an intermediate nickel undercoat has been conducted for a long time on practically all metals but, with a few exceptions, in the case of bright decorative chromium has been found lacking because the deposit does not plate in a bright form on many metals and other metals such as steel are more difficult to polish to high brilliance than is the nickel undercoating and prior high brilliancy polishing of the base metal is a necessity with the weak bright chromium. Particularly with brass and other metals the direct chromium easily flakes away, partly because the base metal is corroded by chromic acid residues under the plate, partly on account of the great differences in the coefficient of thermal expansion between the base metal and the chromium.

Recent Developments

New Methods, Materials and Equipment for the Metal Finishing Industries

Bright Zinc Process

R. O. Hull & Co., Inc., Dept. MF, 1300 Parsons Court, Rocky River 16, O.

Two new zinc brighteners known as Perma-Brite "S" for still or automatic, and Perma-Brite "B" for barrel plating, have been announced.

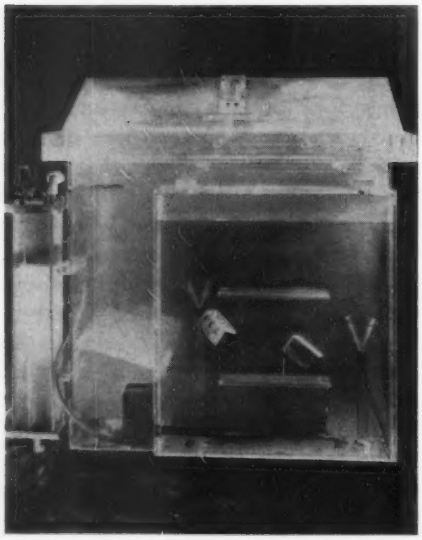
Besides economy of use, notable features of the new zinc brighteners are claimed to be exceptional bright zinc deposits, preferably after bright dipping; high throwing power and covering power; perfect for conversion coatings. In addition, the brighteners are reported to have an extremely wide effective concentration range; added directly to the plating bath once a week or once a day as desired, just as it comes in liquid form; stable in idle baths, it makes zinc anodes corrode smoothly.

After initial addition of brightener, production figures show a consumption rate as little as 1/8 oz./gal. per 40 hour week for still plating. For barrel plating the rate is comparable, based upon ampere hours.

Corrosion Test Cabinet

The G. S. Equipment Co., Dept. MF, 5317 St. Clair Ave., Cleveland 3, O.

A major scientific advance in accelerated corrosion testing of finishes and coatings is stated to be achieved by the completely redesigned Singleton "H-T Sincolite" test cabinet.



For the first time, clearer "picture-window" visability during tests is made possible by the insulating effect of flat-panel water-jackets housing the 2 new electric heaters located front and rear on the outside of the cabinet. Progress of tests can be observed through these windows without opening lid, interrupting the process or handling specimens. This offers a special advantage in short tests of black oxide finishes and other less-protective coatings.

More uniform temperatures are maintained throughout. Danger of "hot bottom" is eliminated which would ordinarily cause vaporizing of contaminated condensate on the cabinet floor.

According to the manufacturer, these new accuracy-factors are enabling users to claim "all test results within 10% of absolute duplication." For operating convenience, all controls are now located at the left end.

The new cabinet is built to meet all existing A.S.T.M. and U. S. Government Specifications for this type of equipment.

Variable Speed Plating Barrel With Automatically Timed Reversing Control

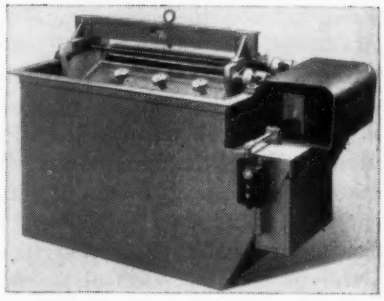
Belke Manufacturing Co., Dept. MF, 947 N. Cicero Ave., Chicago 51, Ill.

Barrel plating of a wider range of work is made practical by a new variable speed drive and/or automatic reversing control.

The variable speed drive provides slipless speed adjustment from 2 to 8 R.P.M. The reversing control includes automatic timing, which is adjustable for intervals from 10 seconds to 20 minutes.

Slower cylinder speeds permit barrel plating work that cannot stand banging, punching or scratching, also fragile objects that tend to twist or bend.

Higher cylinder speeds churn up the work and practically burnish while



plating. They also act to stir up and mix dense work, such as rivets, nuts, etc., and separate flat pieces that tend to stack.

Reversing the barrel rotation reverses tumbling and stirs up the work still more. Reversing with slow rotation increases mixing without increased banging. Reversing with higher speed rotation produces mixing action not obtainable with high speed revolution alone, it is claimed.

Centrifugal Pump

The Deming Company, Dept. MF, Salem, O.

This end suction centrifugal pump is identified as Deming Fig. 4011 Series. Sizes range from 1½ to 5-inch discharge; capacities up to 1,000 g.p.m., maximum heads up to 240 ft. Units can be furnished with electric motor, or for belt drive, or pump only.

Semi-open, non-clogging type impeller has extra heavy, 3-vane construction for exceptional wear resistance in all types of service. Axial shaft adjustment permits moderate regulation of capacity and head.

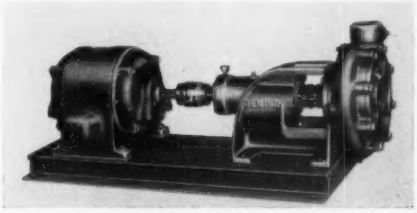
For handling liquids with lime, chips, and such solids which tend to coat metal surfaces, or clog the space between impeller and casing, an impeller with wiping vanes can be furnished at extra cost. This impeller has same advantages as the standard semi-open impeller.

The three-piece, separate liquid end and assembly permits easy maintenance. Liquid end is standard iron construction but can be furnished in proper corrosion-resistant metals for

special requirements without necessity of changing standard iron construction of power end.

Standard equipment provides for stuffing box construction with lubrication by grease or clear water in lantern ring. For abrasive or corrosive service, a pressurized clear water connection to lantern ring is recommended. The flushing type stuffing box construction (furnished at extra cost) is ideal for shaft cooling or high vacuum sealing.

Where required, a mechanical seal construction of double-seal design with pressurized water or grease lubrication is furnished at extra cost but only with stainless steel shaft or shaft sleeve. This construction gives



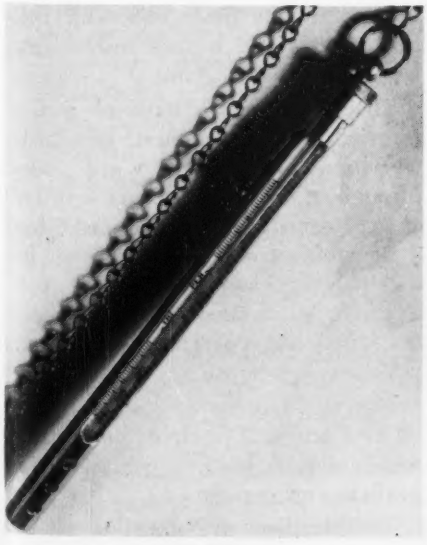
unexcelled, trouble-free service with all types of non-corrosive liquids. Special seal materials are available for use with most types of corrosive liquids. Any type and manufacture of mechanical seal can be installed.

Complete information and performance tables are available in Bulletin No. 4011.

Degreaser Cleanout Indicator

Ramco Equipment Corp., Dept. MF, 1373 Lafayette Ave., New York 59, N. Y.

A boon to users of vapor degreasers is the new Ramco Cleanout Indicator. Developed to save many dollars in cleanout costs, this specially designed



instrument tells the exact condition of the solvent in the degreaser. It eliminates guesswork and makes it a simple and effortless job to keep an accurate check at all times. Calibrated for both trichlorethylene and perchlorethylene solvents, the indicator is easy to read, and may be carried in the breast pocket as readily as a fountain pen. It comes complete with a performance and control chart and instructions on "How To Clean A Degreaser." It sells for $7.50 from the above manufacturer.

Selenium Rectifiers

Walker Division, Norma-Hoffmann Bearings Corp., Dept. MF, Stamford, Conn.

A new line of selenium rectifiers for electroplating and anodizing is available in two types . . . basic rectifiers deliver the voltage and current stamped on the name plate but have no controls. Self contained rectifiers incorporate the basic unit with voltage controls and include instruments, all within single cabinet.

The rectifiers are built of quality material to the highest standards. Oversized components are used throughout. Copper bus bars with low current density are used. In addition, a remote control unit is available for use with the basic rectifier. This control may be mounted at a location distant from the basic rectifier for convenience of operation.

The rectifiers have a power factor of 95% and a D.C. ripple of approximately 4%. A lower ripple content is available on request.

The rectifiers are stated to be ex-

ceptionally efficient. They are frequently used continuously at full load for two or three working shifts.

Bright Zinc Process

Frederic B. Stevens, Inc., Dept. MF, Detroit 16, Mich.

Stevco Bright Zinc Process is the latest electroplating process added to the above manufacturers' new Stevco line of processes.

Developed especially for automatic barrel plating as well as manual and semi-automatic horizontal barrel machines, the new process is stated to produce a bright zinc plate over a wide range of current densities such as are found in barrel plating.

The process is composed of water soluble bright zinc salt and liquid zinc brightener (with tarnish resistor).

Close grain structure in the ductile bright zinc deposit, convenience in handling, high conductivity resulting in fast plating, good distribution of plate and excellent anode corrosion are features of the newest process.

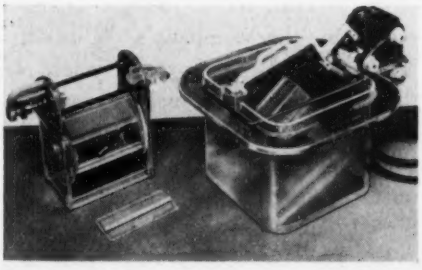
The resultant surface can be bright dipped or given a chromate treatment if called for in the specifications.

Further data and instructions on the use of this process may be found in Technical Bulletin P-130, obtainable from the company.

Plating Barrels

Daniels Plating Barrel & Supply Co., Dept. MF, 129 Oliver St., Newark 5, N. J.

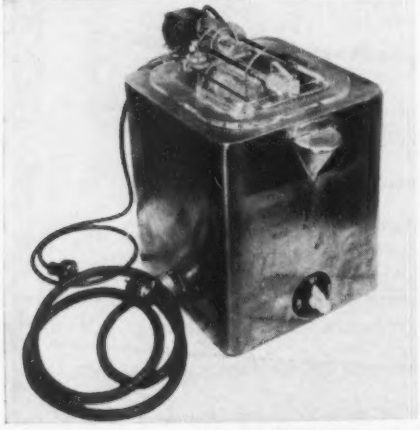
The new 3H, is a miniature plating barrel having a cylinder 3″ in diameter x 3″ deep with approximately ¼ lb. load capacity. It is a complete bulk plating machine, consisting of high temperature Plexiglas tank and cylinder and a 110 volt, 60 cycle, single phase, motor drive. Since tank capacity is only 1 gallon, the unit is ideally suited for precious metal plating



Daniels standard 3H Plating Barrel. Showing interchangeable oblique and horizontal plating cylinders.

where solution volumes must be kept small.

In addition to standard and experimental plating techniques, the barrel is particularly adaptable for cleaning, pickling and deplating of precious metal parts for reclamation.

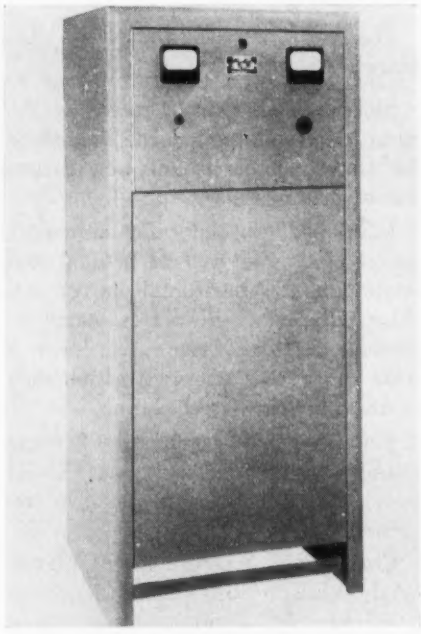


Daniels 3H Precious Metal Plating Unit. With stainless steel water jacket, electric immersion heater and temperature control.

Standard optional equipment includes a cathode rod for still tank plating which can be installed within 5 seconds. A further innovation is an optional horizontal plating cylinder constructed of high temperature Plexiglas, with dangler type negative contacts and single drop in door. This cylinder is 3″ in diameter x 4″ long. The horizontal type cylinder just described is likewise interchangeable with the oblique type cylinder. Either can be installed in line with the operator's wishes. Both units are designed to fit and operate in standard 3H plating tank.

28 Volt, 300 Ampere Rectifier

Perkin Engineering Corp., Dept. MF, 345 Kansas St., El Segundo, Cal.



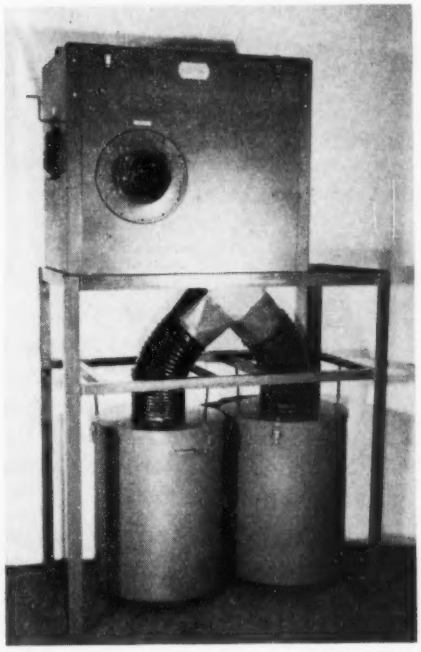
Recently announced is the addition of a new 28 volt 300 ampere tubeless magnetic amplifier regulated power supply to the company's line of heavy duty rectifier units. The new unit identified as Model No. MR2232-300 is rated at 22-32 volts D.C. output at 300 amperes D.C. output and is designed to operate from 230/460 volts, 3 phase, 60 cycle A.C. input with a ± 10% tolerance on the AC input voltage. The unit has a ± 1% regulation and a 1% ripple, is constructed in a floor mounted cabinet with dimensions of 30″ x 25½″ x 72″, and weighs 500 lbs. This power supply uses selenium rectifiers for the conversion elements and saturable reactors for the magnetic amplifier regulation circuitry.

Dust Collector

Aget Mfg. Co., Dept. MF, Adrian, Mich.

A more efficient and easily maintained dust collecting unit has resulted from several recent design changes made in the company's "Dustkop" Model 11w50. The overall height of the unit has been reduced by approximately 10″ by elimination of the standard dust bin, and allows filtered dust, shavings, chips, or lint to drop directly into selected collecting roller cans. The two roller cans plus the diversion "Y" have also been redesigned to permit greater capacity and

ease of maintenance with a cleaner, more airtight system. The all metal, flexible diversion "Y" provides the cans with a better ,more permanent



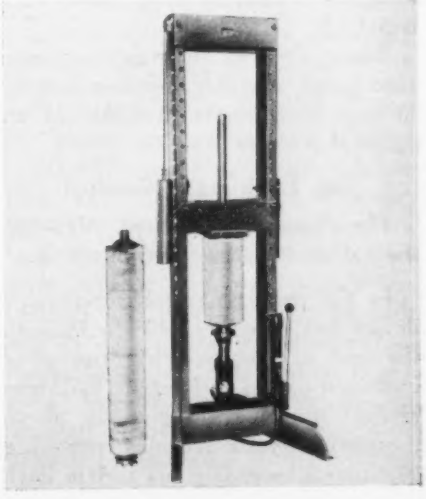
seal, permitting dust to flow more freely and to settle faster. Connecting, disconnecting, and removal of dust roller cans is made easier because of a new lid closing principle. The lid is held in place, during operation, by three easily operated clamps. Lid and "Y" connections are self suspending during roller can removal and dumping operations.

Buff Arbor Press

Clair Manufacturing Co., Inc., Dept. MF, 1009 S. Union St., Olean, N. Y.

Development and production of a new 20-ton hydraulic jack for surface finishing applications has been announced. This arbor press was designed specifically to mount wide-faced buffs on long spindles. Because it is impossible to assemble wide-faced buffing rolls to a uniform density throughout in one operation, it is necessary to compress small segments of buff build-up progressively. With conventional arbor presses, this is accomplished by means of correspondingly shorter hollow ram extensions that fit over the spindle. These hollow extensions frequently cock off-center during compression, and bend the spindles out of line. Hundreds of expensive spindles and out-of-balance rolls are discarded as a result.

The Clair Model L was developed and designed in answer to the crying need for an arbor press that will automatically hold a long spindle in perfect alignment during the loading operation. As illustrated, this has been accomplished by means of an upside-down version of a conventional arbor press. The hydraulic ram, as mounted at the base of the frame, exerts upward pressure on the spindle and serves as a positive location for the dead end. The spindle is automatically centered through an accurate adapter plate attached to the bottom of the quickly and easily adjustable counterbalanced table. The adapter plate slips over the spindle and makes full-faced contact with the buffs. Thus, vertical or sideway thrust against the spindle is avoided, regardless of ram pressure. Accurate adapter plates that conform with the diameter of the spindle being loaded, are readily interchanged. According to the manufacturer, the



model L puts an end to bent spindles and off-balance rolls.

The overall dimensions are: 7′ 4″ high and 2′ 6″ wide. The inside clearance is 60″ high by 17¼″ wide. Ram travel 5″.

Where desired, an indicating pressure gauge assembly, reading directly in ram pressure, is available as an optional feature.

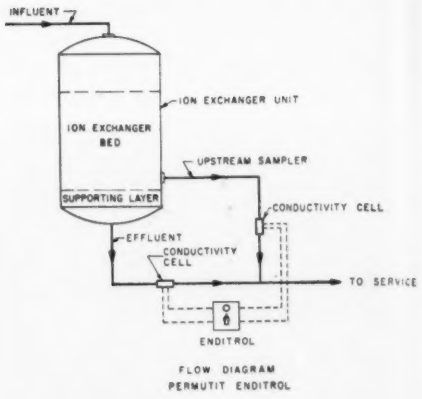
Ion Exchanger Control

The Permutit Co., Dept. MF, 330 West 42nd St., New York 36, N. Y.

In the past, no suitable automatic device has been available to indicate the end of the operating run of a hydrogen cation exchanger (hydrogen zeolite) unit, according to the above company. Control schemes employing continuous recording pH meters have been unsuccessful because the changes in pH at the end of the operating runs are very minute.

A new electronic control has been developed to take advantage of the fact that, as the downflow hydrogen zeolite ion exchanger approaches exhaustion, the hydrogen concentration of the effluent has a higher conductivity than that of the upstream sample. Called the Enditrol, endpoints of the ion exchange run can be simply determined by comparing the conductivities of the upstream sample and the effluent.

Equipped with proper electrical controls, this device can also be used for automatically initiating the operation of existing automatic regeneration equipment. Operation of such units could be made entirely automatic and would eliminate the dangers of over-running and the chemical and water wastages caused by under-running. The device may also be equipped with a relay so that it can signal the end of the operating run by an alarm bell or light arrangement.



FLOW DIAGRAM PERMUTIT ENDITROL

In operation, a continuous flow of water is drawn from the upstream tap and comparison of this tap water with the effluent results in a ratio that is constant until the resins approach exhaustion. The decrease in acidity moves downward during the run and when it reaches the tap, the ratio suddenly changes. This change in ratio signals the end of the run.

This control device is equally applicable to anion exchangers used for silica removal where the anions are taken up in a preferential manner by the ion exchanger bed.

Generator Brushes

Stackpole Carbon Co., Dept. MF, St. Marys, Pa.

New metal graphite brush grades are claimed to greatly prolong brush life, reduce commutator wear and improve the operating effiiciency of electrolytic plating generators.

An improved type stabilizing shunt automatically distributes the current evenly between the various brushes and avoids one or two brushes "hogging" the load. Commutation is exceptionally good. Commutator threading and grooving are greatly reduced and, in some cases, eliminated.

Available brush grades and types meet practically any plating generator requirement. Complete details are available from the manufacturer. Company engineers will gladly recommend a suitable grade upon receipt of current and voltage ratings of the generator in question.

Manufacturers' Literature

Vapor-Spray Degreasers

Ramco Equipment Corp., Dept. MF, 1373 Lafayette Ave., New York 59, N. Y.

A bulletin (No. 754) dealing with the features of Ramco vapor spray degreasers has recently been issued.

Among the many features detailed in this bulletin are the following: non-corrosive stainless steel troughs; life-time corrosion-proof stainless steel condensing coils; one-bolt action doors.

A cross-section illustration of the design of these vapor spray degreasers graphically points up the performance of these machines.

A table showing eight popular, standard models provides information regarding working space, over all dimensions, heat requirements, and solvent capacity.

Oxidizing Liquid

Krembs & Co., Dept. MF, 669 West Ohio St., Chicago 10, Ill.

The above company has prepared a leaflet on Oxy-Dyz-Ene, a concentrated liquid oxidizing solution for oxidizing brass, copper, silver, etc.

Complete instructions are given for treating the various metals to produce different colors.

A generous sample will also be sent to those who request it.

Hand Lift Trucks

Market Forge Co., Materials Handling Div., Dept. MF, 33 Garvey St., Everett, Mass.

A comprehensive and colorful new check chart of features to look for in the selection of Hand-Lift Trucks and Hand Pallet Trucks is Bulletin No. 1005-A.

This analysis of hand-lift equipment includes descriptions, diagrams and illustrations of design and construction with regard to safety, performance and ease of maintenance. Consisting of thirty-four questions relating to essential characteristics, this helpful check sheet provides space for the evaluation and comparison of hand-lift equipment.

In addition, a valuable selection guide, shows new ways to acquire whole fleets of hand-lift trucks for greater materials handling efficiency and at sensationally low cost.

Chemicals

City Chemical Corp., Dept. MF, 132 West 22nd St., New York 11, N. Y.

When the unique manufacturing facilities of the above company were first brought to the attention of the American people just a few years ago, there were only 120 rare chemicals made.

The new brochure of the company now boasts almost 300 new compounds and the list is being constantly expanded.

It is another evidence that the activity in manufacturing special chemical compounds has been intensified, thereby making the United States independent of foreign supplies for the new tools of research and production.

Porous Fluorocarbon Filter

Porous Plastic Filter Co., Dept. MF, 30 Sea Cliff Ave., Glen Cove, N. Y.

Properties of porous "Kel-F" plastic, design and performance data on complete filters equipped with this new filter media, are available in a new brochure which describes several basic types of newly-developed filters, gives data on pore size, particle size removal and flow capacity. In addition to data on porous fluorocarbon media and filters, information is presented on the company's engineering and application services and other plastics in controlled porosity form.

Aluminum Coating

Arthur Tickle Engineering Works, Inc., Dept. MF, 21 Delavan St., Brooklyn 31, N. Y.

A brochure describing the Alumicoat process of bonding aluminum and its alloys to the ferrous metals is now available. A free copy may be obtained by writing the company.

Hard Chromium Services

Hardchrome Electro Processing Corp., Dept. MF, 10 Vandewater St., New York 38, N. Y.

This new bulletin describes the process of industrial chromium plating, differences from ornamental chromium plating and applications. The purposes served by the deposits and the types of tools and articles suitable for treatment are covered in detail, including suggested thickness for various applications and desired hardness of the base metal.

Copies may be obtained from the above company on request.

Filter Cloths

Filtration Fabrics Division, Filtration Engineers, Inc., Dept. MF, 155 Oraton St., Newark 4, N. J.

To help select the right filter cloth for any application in filtration or dust collection, all available engineering data has been assembled in one 6-page, 2-color folder. Feon Dynel, Nylon, Orlon, Polyethylene, Saran and other materials are covered. Of particular interest to process engineers are charts of chemical and temperature resistance, discussion of technical considerations, magnified views of the various weaves available, and performance case histories.

Electroplated Palladium, Platinum

Technic Inc., Dept. MF, Providence, R. I.

Recognizing the industrial need for a valid analysis of the properties of electroplated precious metals now coming into prominence as "industrial metals," the above company has issued an authoritative data sheet on electroplated palladium and electroplated platinum.

For each metal, the compilation describes physical properties, from atomic weight to reflectivity, and electrical properties, from resistivity to specific magnetic susceptibility. Corrosion resistance is also detailed, along with hardness electroplated, electroplating specifications, and thickness requirements. Cost of electroplating per square foot is estimated.

Although the data sheet comprises complete information on both electroplated palladium and platinum, it is organized in convenient form to make all details available at a glance. The firm has elected to follow the format developed in preparing data sheets on electroplated gold and electroplated rhodium, recently issued, whose value to industry's productive and research facilities has been reflected by widespread demand for copies.

Ion-Exchange Applications

Graver Water Conditioning Co., Dept. MF, 216 W. 14th St., New York, N. Y.

Now available is Technical Reprint T-123 entitled "Applications of Ion Exchange to Plating Plant Problems." This is a reprint of a paper given at the recent Ninth Industrial Waste Conference at Purdue University.

This reprint discusses methods of treatment, the use of ion exchange in the plating room, relative advantages of batch and continuous treatment and economic factors among other phases of this increasingly important field.

The paper is illustrated and has several graphical representations of the important considerations discussed.

Plastic Closures

CaPlugs Division, Protective Closures Co., Inc., Dept. MF, 2207 Elmwood Ave., Buffalo 23, N. Y.

To informatively present its expanded line of CaPlugs (polyethylene closures), the above company will send a newly-published illustrated file folder and a representative assortment of samples to those inquiring.

Describing fully and concisely the complete line of threaded and non-threaded caps and plugs for safeguarding products in process, storage and transit, the folder is tabbed and punched for easy filing and finding in either binder or cabinet. Enclosed in the folder are complete price lists for over 100 stocked sizes of the five standardized designs used to protect tubing, fittings, valves, hydraulic components and numerous machined parts.

Plastic Pipe, Fittings & Valves

American Hard Rubber Co., Dept. MF, 93 Worth St., New York 13, N. Y.

Complete technical data on Dur-Ace, a new general-purpose corrosion-resistant plastic pipe with exceptional impact strength and toughness, are given in Bulletin 80-A, just announced. General properties of the multi-polymer rigid plastic pipe, together with chemical resistance tables, standard sizes, pressures, and prices of pipe, fittings, and diaphragm valves are included, together with installation and fabrication data.

Film on Automatic Barrel Plating

Frederic B. Stevens, Inc., Dept. MF, Detroit 16, Mich.

A 16 mm. sound motion picture featuring automatic barrel plating and processing in a true "automation" role is now available.

The operational economy obtained from continuous automatic barrel zinc and cadmium electroplating, bright dipping, rustproofing and washing operations is described. The major portion of the film was made in the new Elgin, Ill., plant of Illinois Tool Works' Shakeproof Division.

In addition to showing the continuous metal finishing and processing cycles, which are handled by single operators, the film features the complete supporting straight-flow "automation" operation from inception of the product through the final finishing treatment.

The film audience is able to see how the straight-flow automation system, employing four automatic barrel electroplating and processing machines, at the new Shakeproof plant moves approximately 500,000 different items through seven major plant departments. No trucks are needed after wire coils have been brought to cold headers in screwmaking department.

To make arrangements for a showing of "Industrial Album" for plant engineers, plant operating group or local trade association the nearest Stevens sales office should be called or write direct to the company.

BUSINESS ITEMS

Frederick Gumm Chemical Co. Announces Retirement of Raymond Berghold

Frederick Gumm Chem. Co. announces the retirement of *Raymond Berghold* on January 1, 1955. "Curley," as he is affectionately known amongst his customers, has been the representative for Western New York State and has made his headquarters in Rochester, N. Y. Mr. Berghold started with the company in April, 1938 and, at that time, covered upper New York State in its entirety. As he developed more new business, it

became a physical impossibility to cover the entire state and he requested the consolidation of his operations in the western part of the state. He will retire under a company sponsored retirement plan. *Emil Pieper* will cover Mr. Berghold's territory after his retirement.

Ardco to Cover Additional Territory for Enthone

Enthone, Inc., New Haven, Conn., manufacturer of metal finishing and electroplating chemical products, announces the assignment of additional territory to their Chicago manufacturing distributor, *Ardco. Inc.* Through their resident sales engineer, *James P. Hendrickson*, Ardco will now service southern Illinois and eastern Michigan from Mr. Hendrickson's office at 3738 Washington Blvd., St. Louis Mo. All Enthone products will be available in this territory with shipment made from Chicago. Purchasers will benefit from the lower freight costs and the shorter time required for transportation. Enthone's service engineer, *Robert Goodsell*, will also be available when needed. Mr. Hendrickson may be contacted by telephone at St. Louis, JE 5-7300.

United Chromium Honors Riotte

Gene Riotte, New York district sales manager of *United Chromium, Inc.*, was recently honored with a luncheon at the Chemists' Club on

Gene Riotte, at left, is shown being congratulated by Richard O. Loengard, president of United Chromium.

completion of twenty years' service with the company. He was presented with a movie projector to mark the occasion.

Mr. Riotte received his degree from the Sheffield School of Engineering at Yale University in 1929. He gave five years to the non-ferrous metals and railroad equipment industries before turning his engineering skills to the metal finishing field.

Chem-Wear Announces Price Cuts on New Line of Dynel Work Clothes

Increasing sales and technical advances in manufacturing have resulted in price cuts averaging 16% on the new line of chemically resistant work shirts, pants and coveralls made of 100% Dynel by *Chem-Wear, Inc., E. S. Smith*, Vice-President of the Darien firm has announced.

Promotions at Alcoa

Three promotions have been announced among the plant metallurgists of *Aluminum Company of America. C. L. Kessler* has been appointed chief metallurgist at Alcoa's Massena (N.Y.) works. *A. M. Miller* will replace Mr. Kessler as assistant chief metallurgist at the company's Edgewater (N.J.) works. *F. O. Traenkner* has been appointed assistant chief metallurgist at the Massena works, the position formerly held by Mr. Miller.

Mr. Kessler, a graduate of Rensselaer Polytechnic Institute, is a veteran of 17 years with the company. He has had wide experience in the manufacture of aluminum sheet, foil, screw machine products, impact extrusions and tubing while serving as a metallurgist at Edgewater. He had been assistant chief metallurgist at that location since 1951.

Since joining the company, Mr. Miller has served continuously as a metallurgist at the Massena works with the exception of a two year assignment at the company's war-time plant in New Castle, Pa. A graduate of Lehigh University, he was appointed assistant chief metallurgist at Massena in 1951.

Mr. Traenkner, a graduate of Penn State, has worked for the firm's Aluminum Research Laboratories and was employed as a metallurgist at the company's works at Lafayette, Ind., Cressona, Pa. and Massena before assuming his new position.

New Equipment Firm

J. Kennelly announces the formation of a new firm, *Atlantic Equipment & Supply Co.*, at 103-21 111th St., Richmond Hill 19, N. Y., telephone VIrginia 8-5228.

The firm will specialize in abrasive machinery and equipment, grinding wheels, abrasive belts, buffs and polishing compounds.

Cothran Wins Oakite Award

W. W. "Wes" Cothran, of Indianapolis, receives the 1954 D. C. Ball Distinguished Service Award from *John A. Carter*, president of *Oakite Products, Inc.*, a leading manufacturer of industrial cleaning and related materials. Mr. Cothran has represented Oakite in Indianapolis for the past 21 years.

The award, named in honor of the founder of the firm, is given annually to the company technical service representative who has rendered exceptional service to industry. The selection is made from the company's 225-man field organization in the United States and Canada. Mr. Cothran received the plaque at the company's Midwestern technical sales conference recently held in St. Louis.

Johnson Succeeds Hawke at Carborundum

Clarence E. Hawke, vice-president of *The Carborundum Co.* and general manager of the company's Refractories Division in Perth Amboy, N. J. has retired from active direction of the division, and *Boyd M. Johnson*, formerly assistant general manager, has been appointed general manager according to an announcement by *General Clinton F. Robinson*, president.

Mr. Johnson, in 1920, shortly after receiving his B.S. degree in Mechanical Engineering from the University of Pennsylvania, joined The company as a maintenance engineer. In 1921 he became product design engineer for the newly organized Refractories Division. Subsequently, chief of the engineering department, manager of engineering, sales manager, works manager, assistant manager and acting works manager. He was promoted to assistant general manager in 1952, the position he held prior to his recent promotion. In his new capacity he will report to the president.

New Permutit Sales Engineers

The Industrial Sales Department of *The Permutit Co.*, New York, N. Y., has announced the appointments of *K. G. Barnhill* and *E. J. Connelley* to the positions of sales engineer at Bos-

ton, Mass., and Cincinnati, Ohio, respectively.

Mr. Barnhill will assume the duties of *E. L. Root*, deceased. He joined the organization in 1939 and served at the Cincinnati office until his new assignment.

Mr. Connelley will assume the duties of Mr. Barnhill. He became associated with the company in 1948 and actively served in the Chicago, Ill., office under the direction of *W. H. Mitchell*.

With many years of sales and service experience in the fields of water treatment, both are well qualified to give counsel on any water conditioning subject.

Ardco Appoints Hendrickson

Ardco Incorporated, Chicago, Ill., manufacturer and distributor of metal finishing chemicals and supplies, announces the appointment of *James P. Hendrickson* to their sales staff with headquarters in St. Louis, Mo. Mr. Hendrickson will be responsible for the sale of Ardco and Enthone products manufactured at the Chicago plant and distributed products of other well known companies. His territory includes eastern Missouri and southern Illinois.

The St. Louis office is located at 3738 Washington Blvd. and can be reached by telephone at JE 5-7300. Mr. Hendrickson joined the organization after several years of production experience with a nationally-known electrical appliance manufacturer. He is a graduate of Arizona State College.

Vereeke is Promoted to Executive Vice-President of Heil

Edwin Vereeke

Promotion of *Edwin Vereeke* to the position of executive vice-president of *Heil Process Equip. Corp.* has been announced by that company. Vereeke previously had been vice-president in charge of sales for Heil, a Cleveland manufacturer of chemical-resistant tanks and linings, acid heaters, lead anodes, plastic ventilating systems and related products.

Mr. Vereeke has been with the company since 1946. Prior to that time, he spent three years as an officer in the United States Navy. He is a graduate of Ohio Wesleyan University, and a member of the National Association of Corrosion Engineers.

New Sales Representative for Shriver

T. Shriver & Co., Inc., of Harrison, N. J. announces the appointment of *The Watts Company* of Houston, Tex. as its executive sales representative for Shriver pumps and filters in southeastern Texas and all of Louisiana, with the exception of the sugar industry.

Ralph L. Watts, principal of the organization, received his Bachelor of Science degree from Texas A. & M. He worked in the drilling department of the Taylor Refining Co. at Alice, Texas, for a period and then became associated with the Duriron Co. of Dayton, Ohio. He served as manager of their Philadelphia branch for three years. He resigned from the Duriron Co. to become vice-president of Small Parts Manufacturers Co., Barrington,

R. I., in which capacity he remained until his return to Texas to form The Watts Co., which is located at 4101 San Jacinto St., Houston 4, Tex.

Aget Mfg. Co. Combines Divisions

Sales and manufacturing divisions of *Aget Mfg. Co.*, Adrian, Mich., have been combined at the company's executive headquarters, 1403 East Church St., according to *James W. Roberts*, general manager. Previously, for fifteen years, Aget's marketing headquarters were at Ann Arbor, Mich., where sales were made through the company's exclusive agent, *Aget-Detroit Co.* This agency arrangement has been terminated, Roberts said, and sales headquarters moved to establish closer manufacturing, sales and dealer relationships. Since 1939, the firm has been a producer of dust and vapor collectors, sold under the trade name "Duskop."

Hooker Adds to Staff

Six technical employees have recently joined *Hooker Electrochemical Co.* They are: *Ralph Resnick, Roger N. Pauls, Joseph A. Gilles, John D. Parkes, Donald W. Brown* and *Richard F. Zimmermann*, all assigned to the process study group. The announcement was made by *F. Leonard Bryant*, works manager, Niagara plant.

Durkin Heads New Firm

A. E. Durkin has formed a new company, *American Metal Processing*, which will specialize in functional plating and processing. The firm is located at 76 Water St., Wakefield, Mass.

For the past fourteen years Mr. Durkin had been associated with the General Electric Co. as an engineer and specialist on organic and inorganic finishes.

A. E. Durkin

Dr. Lancy Retained by American Plating, Inc.

As electroplaters for industry, *American Plating, Inc.* in Zelienople Pa., has a unique position in the presence of *Dr. Leslie E. Lancy.*, the firm's vice-president. Dr. Lancy is a noted plating consultant and inventor of a special integrated waste treatment system for the electroplating industry. Information on his waste treatment process has been widely disseminated in technical journals, including METAL FINISHING (February, 1951 and July, 1954).

Born and educated in Hungary, Dr. Lancy studied chemistry, electrochemistry and metallurgy before receiving his Ph.D. degree in 1933 at Szeged University. He came to the United States in 1939 and became affiliated with the electroplating firm in Ellwood City which has since become American Plating, Inc. in Zelienople. His waste treatment system is being incorporated in the new American Plating plant.

As an activity devoted purely to research and development in the metal finishing field, Dr. Lancy established Lancy Laboratories. His fully equip-

Dr. Leslie E. Lancy

ped laboratories perform corrosion engineering, testing of process solutions, coatings, metallic deposits, and other research and development on finishes. Lancy Laboratories are located in a section of the new American Plating plant and thus give the latter firm the unusual service of being able to render quick and thorough technical advice on electroplating.

The Carborundum Co. Adds to California Facilities

The Carborundum Company has just completed two new warehouse and office buildings in California, and has reorganized sales, engineering and other services in the West into what is now designated the Pacific District, which includes the area west of the Rockies. *John G. Fritzinger*, formerly a sales executive in Niagara Falls, N. Y., has been named manager of the district, according to an announcement by *General Clinton F. Robinson*, president of the company.

The Pacific District organization will bring together in a coordinated program the product sales and engineering services of all divisions of the company.

The new warehouse and office buildings are located near Los Angeles and San Francisco. The Los Angeles structure, located at 2626 South Malt Ave., provides 13,000 sq. ft. of floor space for warehouse functions and 2,000 sq. ft. for office operations.

The other one-story building erected at the corner of Alviso Road and Evelyn Ave., Mountain View, Cal. (near San Francisco) provides 18,000 sq. ft. of floor space for warehouse use, 2,000 sq. ft. for lathe room and service area, and 1,600 sq. ft. for office functions. Both facilities are convenient to railroads and main highways and are equipped with car height loading docks and modern materials handling facilities.

Product inventories will be maintained in these warehouses and at the Vancouver plant to supplement stocks carried by the company's distributors in the area and thus help to insure prompt service to customers throughout the Pacific District.

Mr. Fritzinger has established headquarters in the Los Angeles office. *W. B. Summers*, sales manager for coated products, and *W. H. Homeyer*, sales manager, merchandising, also will

have headquarters there, and *Wilfred Robson* has been designated office manager for the Los Angeles office. *F. J. Blake*, sales manager for bonded products & grain, will be located at the Mountain View office and *James Meehan* has been appointed office manager there.

International Nickel Increases Nickel Prices

To assist in offsetting higher production costs, *The International Nickel Co. of Canada, Ltd.*, announced an increase of 4½c (U. S.) per pound in the price of refined nickel, effective November 24, 1954. Like increases were announced by the company's United States subsidiary, *The International Nickel Co., Inc.*, and its United Kingdom subsidiary, *The Mond Nickel Co., Ltd.*

This brings the export price of electrolytic refined nickel, from the Port Colborne, Ontario, refinery, to 64½c (U. S.) per pound, including the 1¼c U. S. import duty which is paid by the company. At existing exchange rates the corresponding price in Canada will be 61.4c per pound Canadian currency.

McNally Joins M. E. Baker Co.

Charles E. McNally has joined the *M. E. Baker Co.* staff as sales engineer. He comes to the company with a wealth of background and experience having received his B.S. Degree in Chemistry from the University of New Hampshire. He took special courses in electroplating at M.I.T., worked 12 years for General Electric Co. as superintendent of plating and

Charles E. McNally

metal finishing and more recently was sales engineer for Almco Division of Queen Stove Works.

Heil Process Makes two Promotions

Heil Process Equipment Corp., Cleveland, manufacturers of chemical-proof equipment such as tanks and tank linings, anodes, heat exchanges, etc., announced the appointment of *Peter L. Veit* as direct sales engineer to cover the eastern states. His headquarters are at 152 West 42nd St., New York. Also promoted to chief engineer of the company is *Fred W. Arndt.*

Mr. Veit, formerly was associated with Gruman Aircraft Engineering Co. as a process engineer. He is also well-known throughout the plating industry, having contributed articles on subjects pertinent to that industry.

Peter L. Veit

Fred W. Arndt

J. Robert Greenwell

He is a member of the *American Chemical Society*, *American Society for Metals*, and is an active officer of the New York Branch of the *American Electroplaters' Society*.

Mr. Arndt, in his new capacity as chief engineer, has had wide experience in all phases of sales and engineering in the process equipment field. He received his chemical engineering degree from Pratt Institute and his M.S. degree from Stevens Institute of Technology. He is a member of the Cleveland Engineering Society.

Greenwell Announces Acquisition of Reliable Plating Corp.

Acquisition of *Reliable Plating Corp.*, 1538 W. Lake St., Chicago, effective November 1st, has been announced by the firm's new president and treasurer, *J. Robert Greenwell*, formerly vice-president of *Chrome-Rite Co.*, Chicago. Vice-President of the newly acquired firm will be *Joseph B. Becker*, also associated with Chrome-Rite until recently.

Greenwell is currently president of the *National Federation of Metal Finishers* and is one of only three men to have held the position of chairman of the *Chicago Electroplaters Institute* for two terms. He served that organ-

ization during 1950 and 1951, after several years as a director of the association.

Oakite Conferences Stress New Materials, New Cleaning Equipment

Ninety-one technical service representatives from the eastern and Canadian divisions of *Oakite Products, Inc.*, gathered together at New York's Statler Hotel in November to share industrial cleaning experiences and to hear company chemists describe the properties of materials recently introduced.

Features of the three-day conferences were the informal discussions in which the representatives reported on the problems they encountered in plants, and the sometimes unorthodox ways in which they solve them.

One hundred and twenty-five representatives from the company's other divisions took part in similar conferences in St. Louis and Los Angeles.

Almco Appoints Representative

Appointment of *Montague-Harris & Co.* as exclusive southern California, Arizona and southern Nevada sales representatives for the Almco metal finishing line has been announced by *Robert Trow*, vice-president and general manager of *Almco Division, Queen Stove Works*, Albert Lea, Minn.

Montague-Harris and Co. will offer an intergrated line of machinery, equipment and compounds for the barrel finishing of metal parts. In addition, they will make engineering assistance available to manufacturers in their area for the solution of specific metal finishing problems. They are located at 3509 east Olympic Blvd., Los Angeles, Cal.

Completing a sales agreement recently in Los Angeles are (l. to r.) Ray Krieger, Don Montague, Dick Johnson all of Montague-Harris & Co. and Robert Trow, vice-president and general manager of Almco.

Pancoast will Represent Pennsalt's Metal Processing Dept. in N. Y. Territory

M. S. Pancoast will represent the Metal Processing Dept. of the *Pennsylvania Salt Mfg. Co.* in its New York territory, Sales Manager *J. J. Duffy* has announced. He will succeed *Clinton S. Burhans* who retires as a result of injuries incurred in an automobile accident five years ago. His headquarters will be in Syracuse.

Mr. Pancoast, a native of Springfield (Del. Co.) Pennsylvania was graduated from Pennsylvania State University in 1951, where he majored in chemistry. Until joining the company in 1953, he was a member of the faculty of Ridley Park High School.

Following a one-year assignment to administrative duties in the Metal Processing Depts.' Philadelphia headquarters, Mr. Pancoast completed the company's technical sales training program. In his new capacity, he will handle the complete line.

Free Course in Electroplating Enroll for the Spring Term

Course in Electroplating given at the *Brooklyn Technical High School*, 29 Fort Greene Place, Brooklyn, New York.

Classroom discussion and laboratory exercises divide the time for the course. A general review of the elements of chemistry relating to plating operations and simple calculations required to understand solution preparations are covered in the class studies. The fundamentals of series and parallel electrical circuits are also reviewed. Such topics as pH, wetting agents, brighteners, buffer action, anti-pitting agents and deionizing are introduced in the study of common tank solutions. Laboratory exercises provide for individual experiments in methods of analysis of copper, nickel and cyanide baths. Additional laboratory work includes Hull Cell studies, pH meter operation, anodizing, immersion plating, thickness measurements.

Registration begins January 17, 1955. Classes meet on Tuesday and Thursday from 6:45 to 8:15 P.M., plus about six Fridays for the term. The term begins February 1, 1955 and ends June 30, 1955. Register with the instructor, Mr. Louis Serota in Room BW17 or Room 3E10.

J. L. Osborne, Chairman of Board, Keystone Chromium Co., Buffalo, N. Y., shows Nathaniel Hall, Editor Metal Finishing, a bend test specimen in the new electroless nickel installation of the American Locomotive Co. at Dunkirk, N. Y. Messrs. A. S. Denton and John Parina, Jr. look on. About twenty editors flew from New York on a chartered plane to inspect this new plating plant.

LETTER TO THE EDITOR

Dear Mr. Hall:

I got a great deal of satisfaction out of reading your very much to the point editorial, "How Much Are You Wasting?", in the October issue of METAL FINISHING. It's about time our industry stopped being so wasteful with nature's wonderful bounty — We need more hard hitting editorials like this one to awaken the industry.

I also read with interest Mohler's article on "Counter-flow Rinse Tank Design." This is a step forward in the direction of better rinsing and water conservation, in line with your editorial. However, I feel several points brought out by Mohler merit further discussion.

The first thing that gave me concern is the inference in the fourth paragraph of his article, that the rinsing equations developed by me are not "usable." This is just not so. The approximate equation and the nomograph given by me in the Dec. 1949 issue of MF and the 1951 METAL FINISHING GUIDEBOOK gives the identical results as his proposed equation No. 5 for any given case. In fact the two equations are exactly the same, basically, so if my equation is not usable then obviously neither is his!

The second point of interest is the statement quoted from Pinkerton[1] that "the size of the rinse tank does not influence the equilibrium concentration." Again I must differ; experimental evidence indicates that it does[2], though it is true of course that for most average cases it has little influence. Evidently Mohler failed to read my rebuttal of Pinkerton's conclusion in a later issue of *Plating*.[3]

The use of a standard orifice for controlling the water flow as proposed by Mohler is a good idea but in my humble opinion, the Measure flow[4], is a far more practical gadget for the plating shop. This simple fitting which attaches right to the inlet pipe, holds the water flow to a given set value, plus or minus about ten per cent, regardless of water pressure fluctuations and sells for less than ten dollars. Installation of these units is a definitely worthwhile thing for any plating shop.

Sincerely yours,

Joseph B. Kushner

1. Pinkerton, Plating, 39, 1016 (1952).
2. Hendel, Herrman & Marino, Symposium Rinsing, A.E.S. Official Program, July, 1954.
3. Kushner, Plating, 40, 617 (1953).
4. Kushner, Met. Fin. Aug., 1951.

News from California

By Fred A. Herr

Lawrence D. Van Osdell recently opened a new plating shop under the name of Metalcraft Industries at 9124 Main St., Los Angeles. He was formerly in partnership with *Don Steel* and *Howard Merrill* in the operation of the

California Metal Processing Co. at 1518 West Slauson Ave., one of the larger Los Angeles finishing firms specializing in anodizing, chromating, cadmium plating and magnesium treatment of aircraft parts.

Van Osdell recently sold his interest in that plant to Steel and Merrill to go into business for himself. His new plant has an initial floor area of 4,000 square feet and is equipped with bronze and brass tank facilities and complementing equipment for specializing in trophy plating.

J. C. Hardy, president of Automotive Service Co., Ltd., Honolulu, T. H., was a visitor in Southern California in mid-December. Mr. Hardy operates the largest job plating shop in the Hawaiian Islands. He specializes in industrial hard chrome plating and anodizing, does considerable copper and nickel work and some decorative plating. His is the largest of the three metal finishing shops in the islands, all in Honolulu. He has been active in plating there since 1934. Hawaii, Mr. Hardy reports, has little or no large industrial plants, so that large volume and big automatic and semi-automatic plating lines are strangers to Island platers. He is a member-at-large of the A.E.S. and attended the December 8th meeting of Los Angeles Branch.

This column was pleased to receive a note from *Andrew J. "Carload Andy" Ospring*, a well known figure in plating and plating supply circles of Southern California, who retired several years ago and apparently vanished into the depths of the San Fernando Valley of Los Angeles.

Andy reports that he is making his "retirement" stick this time. He occupies his time with his garden and an occasional visit to the Burbank, Calif., Elks Club. But, between lines, one seems to read that Andy is fretting at the reins like a fire horse anxious to get back into harness. Andy acquired his nick-name of Carload Andy during the days when he worked as a salesman for Oakite Products, Inc., in Tulsa, Okla. Oakite was still known as Oakley Chemical Co. in those days, when Andy developed the admirable habit of selling chemicals by the carload. During the past thirty years he served in sales capacities for Oakite Magnus, Turco, L. H. Butcher Co. and Sundmark Supply Co., and as a process engineer for Menasco Mfg. Co., Grand Central Aircraft and Hydro-Air Products in Burbank.

For 16 years prior to entering the plating supply field, he worked as a railroad engineer and "never had an accident," he writes. He started railroading as a fireman in 1906, and ran engines on the St. Louis Division of the Pennsylvania Railroad, the Union Pacific out of Cheyenne, Wyoming, and the eastern division of the Santa Fe, westward from Kansas City. That he still holds fond memories of his railroading days is indicated by the fact that his personal letterheads today carry a picture of a railroad locomotive, with the caption "Carload Andy ran this engine in 1910." Another photo shows him in the cab of a 1906 coal burner. The plating industry of Southern California misses

Carload Andy and his perpetually genial smile, and wishes he would drop around to an A.E.S. meeting occasionally.

Stanley Golnicik was named superintendent of plating for the Advance Plating Co., Huntington Park, Calif., effective on December 1. He succeeded Chick Sales who recently resigned. Golnicik was formerly with Lewis Metal Plating Co. in St. Paul, Minn.

Advance Plating also announced the appointment of *Edward Barrett* as sales engineer. Prior to coming to Southern California, Barrett was affiliated with the Chrome Division, Precision Tool Co., in Lansing, Mich., and as a union representative of the United Automobile Workers in Detroit.

The departments of engineering and university extension of the University of California at Los Angeles, in cooperation with the western regional division of the National Association of Corrosion Engineers, presented a course in protective coatings at Los Angeles November 15, 16 and 17. The course was pointed to the needs of process chemical, petroleum, marine and other industries arranged to precede the program of the Western Regional Division meeting of the NACE November 18 and 19.

Technical papers followed by discussion were presented on such subjects as: "Metallic Coatings," by *Bertram Smith* of Metallizing Engineering, Inc., Los Angeles; "Surface Preparation" by *Arno J. Liebman*, Pitman Centrifugal Machine Co., Pittsburgh, Pa; "Coal Tar Coatings" by *George B. McComb*, Standard Pipe Protection Co., St. Louis. Mo.; "Ceramic Coatings" by *J. E. Hansen*, Ferro Corp., Los Angeles; "Theory of Protective Coatings," by *Francis K. Wilson*, Menlo Park, Calif.; and "Paints" by *Leo Forth*, Sherwin-Williams Co., Los Angeles. A panel discussion participated in by all programed speakers was held on the afternoon of the third day.

The El Segundo, Calif., division of Douglas Aircraft Co., has completed installation on and now has in operation a new flow coating system that is claimed to be the longest continuously moving paint line of its type, with a capacity for flow coating 6,400 Navy jet plane parts per hour. It is described as a monorail system, electrically powered, 2,600 feet in length, with an operating speed of 10 to 30 feet per minute.

The new installation is said to afford more uniform paint distribution over the parts and to eliminate the sagging or "drooping" of paint which some times occurs in tank dipping or high-pressure spraying of large volumes of airplane parts. It handles parts from a square inch in size to 6 feet long. The items are suspended from loops attached to hooks fixed at 4 inch intervals along a roller chain on the monorail. Stainless steel hooks are used.

William H. Eisenman, Cleveland, O., secretary, American Society for Metals, arrived in Los Angeles at the end of November for conferences with committees of Los Angeles Chapter of the ASM to discuss plans for the Ninth Western Metal Congress and Exposition which will be held for four days beginning March 28 at Pan Pacific Auditorium, Los Angeles.

Eisenman has opened executive headquarters in the Ambassador Hotel,

where sessions of the Western Congress technical conference will be held while the exposition is in progress in Pan Pacific Auditorium.

West Coat metal fabricators, processors and finishers and manufacturers and distributors of metal industry equipment were well represented at the 36th annual National Metal Congress in Chicago, Ill., in November, which served them as a preview of what may be looked for in Western metal developments at the Los Angeles exposition in March.

Western manufacturers and processors who exhibited at Chicago included the following:

Baron Industries, Los Angeles, displayed in operation a barrel vapor degreasor, exhibiting models SBD-E and BRD. *Vacu-Blast, Inc.*, Belmont, Calif., showed its utility and junior models in blast cabinets, nozzles and dust collectors, and blast rooms. *Applied Research Laboratories*, Glendale, Calif., exhibited laboratory plating thickness gauges and a curved crystal X-ray industrial quantometer. *Turco Products, Inc.*, Los Angeles, presented metal parts formed and sculptured by the new Chem.-Mill precision forming process. *Met-L-Chek Co.*, Los Angeles, was represented by a display of metal testing compounds; *Clementine, Ltd.*, San Francisco, by sandblast cabinets, pots, valves and nozzles. Others from the West Coast included *Consolidated Vacuum Corp.*, Pasadena; *Ace Drill Bushing Co.*, Los Angeles; and *U. S. Electrical Motors*, Los Angeles.

Mido Products Named West Coast Distributor for Norton Co.

Arthur Pine, president of *Mido Products*, announced that his firm will act as a West Coast distributor for the *Norton Company* of Worcester, Mass.

Mido Products will carry a complete stock of alundum tumbling abrasives at their manufacturing plant, 1801 Border Ave., Torrance, Cal. Present operations at the plant of interest to the barrel finishing industry include a complete line of barrel finishing compounds and cleaners which in conjunction with the tumbling abrasives will provide a complete laboratory and technical service for West Coast customers.

Associations and Societies

AMERICAN ELECTROPLATERS' SOCIETY

Grand Rapids Branch

The Grand Rapids Branch of the A.E.S. will hold its annual Educational Session and Dinner Dance on February 19, 1955 at the Pantlind Hotel in Grand Rapids. The program will be as follows:

Educational Session: Saturday, February 19, 1955, at 1:00 p.m. Continental Room, Pantlind Hotel, Grand Rapids, Michigan. Chairman: *C. F. Nixon*—head, Research Labs. Div., General Motors Corp., Detroit Mich.

Papers and Speakers: 1. "Chrome Reflections" — *Floyd G. Lawrence*, automotive editor, Steel magazine. 2. "Production and Applications of Titanium"—*Ward W. Minkler*, assistant manager of product development, Titanium Metals Corp. of America, New York, N. Y. 3. "Developments in A.E.S. Research"—*L. C. Borchert*, vice-chairman, A.E.S. Research Com-

mittee, Houdaille-Hershey Corp., Detroit, Mich.

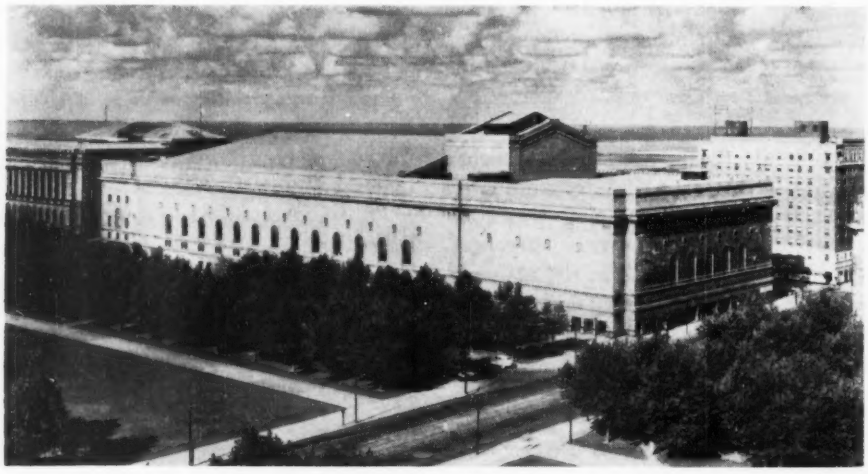
Annual Dinner - Dance: Saturday, February 19, 1955, at 7:00 p.m. Main Ballroom, Pantlind Hotel, Grand Rapids, Michigan. Tickets may be secured from *J. J. Hanney* 129 Arthur N. E., Grand Rapids, Mich.

Kenneth Hampel,
Publicity Chairman

1955 PLATING SHOW TO BE LARGEST EVER STAGED

According to the list of exhibitors, who have already signed up for the 1955 Industrial Finishing Exposition, the show will be much larger than the 1952 Exposition. The show is scheduled to open at the Cleveland Public Auditorium on June 20th, 1955.

The Industrial Finishing Exposition serves a great need in the industry and is unique in the fact that it provides a good medium for the mutual exchange of ideas between equipment builders and equipment users. The 1955 Exposition will be the first show held in three years. Those in the industrial finishing industry agree that the show in 1955 will be important because during the three-year interim, between shows, there have been many important improvements and advancements in industrial finishing equipment, processes and services.



Cleveland Public Auditorium

The program at the A.E.S. Convention and the Exposition itself will be of interest to both organic and inorganic industrial finishers. Because of the many new papers to be presented, and in view of the important advancements to be exhibited, an equipment user cannot help but pick up at least one idea that can be beneficial by saving money or improving operations at the users plant.

Los Angeles Branch

Los Angeles Branch closed out its 1954 series of meetings with a social session and entertainment program at Rodger Young Cafe on the night of December 8.

The affair attracted an attendance

of approximately 100 members and guests—one of the largest crowds of the year—as the result of effective advance publicity created by President *G. Stuart Krentel* and Membership Chairman *Earl W. Arnold.*

The session marked a policy in Branch affairs in that the regularly scheduled monthly business and technical meetings will hereafter be varied with occasional social evenings.

All business and technical discussion was thrown overboard for the December 8th gathering in favor of a program of sociability and entertainment. Even the customary steak and/or prime-ribs-of-beef dinner was varied in favor of a help-yourself Smorgasbord menu, of which the most popular feature was the fact that one could return for another helping as often as the need was indicated. As an added attraction, the Branch sponsored the distribution of free refreshments. The evening developed into a carefree one of singing and general talk, with quartets and quintets of songsters at one end of the hall giving forth valiantly with "The Trail of the Lonesome Pine," oblivious of another group at the other end which belabored the rafters with renditions of "When You Wore A Tulip" and "Put On Your Old Gray Bonnet." The program was topped off with a motion picture of the recent Mexican Automobile Road Race.

The 1955 schedule was to open with a regular business session and technical talk on the night of January 12. The next non-technical session is due in March when annual election night is to be programmed as a social meeting, with business confined to nomination and election of officers.

Meanwhile, President Krentel and *Earl W. Arnold*, vice-president in charge of membership, plan to spur the branch to renewed efforts during the spring months in order to keep the current membership drive rolling in high toward the achievement of a total of some 400 branch members before the close of the first-half activity on the second Wednesday in June.

Waterbury Branch

On October 14th, the regular monthly meeting of Waterbury Branch featured a local talent night. A panel consisting of Messrs. *Harry Streeter, Bert Sage, Tony Maz, Harry Haines,* and *Frank Terendi* discussed "Methods of Barrel Finishing." Moderated by *Izzy Cross*, the panel answered questions from the floor.

A discussion was held at the regular monthly meeting on November 11th to determine the advisability of continuing the procedure of dinner at 6:00 p.m., business meeting 7:00 p.m., and technical session at 8:00 p.m. It was decided to continue this practice. President *Perry Sloane* introduced *Lou Porretti* who acted as technical chairman. After a book review by *George Dubpernell* and a movie on Bermuda, Mr. Porretti introduced *Dr. Harold Narcus*. Dr. Narcus spoke on "Plating Non-conductors." A lively discussion followed.

William P. Innes,
Publicity Chairman

Buffalo Branch

The Buffalo Branch met Friday Nov. 5, at the Markeen Hotel. Two new members were admitted: *J. Ru-*

pert Kenny, Kenmore, N. Y., and *Harold Shapiro*, Buffalo, N. Y.

One transfer from the Rochester Branch was *Platt K. Wiggins, Jr.*, Kenmore, N. Y.

The program consisted of a talk by *John Swift* of the Swift Industrial Chemical Co. on the subject "*What the Plater Should Know About the Metallurgy of the Basis Metal.*" The talk was followed by a discussion period in which several members joined.

Eric G. Sampson, Jr.,
Secretary

Grand Rapids Branch

The November 5th, 1954, dinner meeting of the Grand Rapids Branch, was held at the *G and J Stag Bar*, with about 45 members in attendance.

President *Carl Green* announced that *Frank Savage* was now a member of the Grand Rapids Branch.

The special guest was, *Mr. Santilohano*, European representative of the Harshaw Chemical Co.

It was also announced that *Charlie Werft* had now made provision for a third place in his awards for the branch. The third place award offers $50.00 for a member whose paper is adjudged the third best at a national convention.

Librarian *Tom Henner*, introduced the speaker, *Dr. M. M. Beckwith*, Division Manager, Harshaw Chemical Co., who spoke on "Electro-leveling Nickel deposits."

Two interesting features were brought out in his talk:

1. Leveling in scratches, is due mostly to a "concentration gradient" of the organic addition agent in the cathode film. Less organic addition agent gets to the bottom of scratches, thus there is less overvoltage (resistance to deposition) in these recesses and more plate goes to the bottom of the scratches, than to the high points, and this brings about the leveling effect. For leveling, there must be developed a critical differential of overvoltage between the high and low current density points.

2. The crystal orientation and stressed condition of the base metal also influences the deposition rate. For instance, there may be a difference of potential, of 20 millivolts on different faces of the same crystal. Crystals under stress, also exhibit different potentials than crystals which are not stressed. Leveling is not just concerned with filling in scratches, etc., but it also has to reckon with the state of the crystal structure of the base metal.

Dr. Beckwith demonstrated the leveling properties of various nickel plating baths by the use of phonograph records. A "Mother" record plated with grey (Watt's type) nickel, produced a record with a very scratchy sound due to a slight filling in of the grooves. Bright nickel deposits did not greatly effect the sound production because of very little filling in of the grooves. With a semi-bright leveling nickel bath the plated record stamper produced a record that was very distorted; the volume was low and the difference of tone or pitch was practically gone, because of the almost complete leveling of the record grooves. Dr. Beckwith stated that a method of checking the leveling of electro-deposits is being investigated, using sound analysis.

Kenneth Hampel,
Publicity Chairman

Louisville Branch

The Louisville Branch held a Ladies Night-Special Program Meeting on Thursday, October 21, 1954, at Kapfhammer's Party House, 1506 S. Shelby St., Louisville, with a dinner served at 6:30 P.M. President *J. W. Scholl* opened the meeting at 8:00 P.M. with 22 members and guests present.

Since this meeting was especially prepared as a social with the ladies present Mr. Scholl decided to dispense with the formalities of the business meeting. At this time he introduced *Stanley J. Beyer*, as chairman of the night's program. Stanley then proceeded to speak on the start of the Louisville Branch, its charter members and the work that was involved in getting the branch going into the serious functions which it now enjoys. Mrs. Beyer then spoke on the fine social and educational sessions attached with the ladies attending the national or regional functions and stressed that all who can should attend these functions as they are immensely interesting with a lot of fun included.

Wm. Young, of the Cincinnati Branch, gave a report of the Tri State Regional Meeting, to be held in Columbus, Ohio, on March 26, 1954, and stated that the meeting is in full swing to make this a very successful Tri State Regional Meeting composed of the Cincinnati, Indianapolis, Dayton, Columbus, and Louisville Branches. He stressed the importance of the branch attendance to this fine affair by everyone who can come as they will certainly enjoy it.

After this session Mr. Beyer introduced the speaker of the program, *Al Aronson*, columnist of the Louisville Times, and former managing editor of the Louisville Times for 28 years. Mr. Aronson, in his talk, told of his experiences with the University of Indiana, Detroit, and Port Huron. Mich., as a newspaper man and the growth of the newspapers from 1907 such as the reporting times of those days onto the present time.

J. G. Sterling,
Secty.-Treas.

Chicago Branch

Chicago Branch held its regular monthly meeting at the Western Society of Engineers, December 10, 1954, where members were addressed by *V. L. Richards*, works manager of Canadian Hanson-Van Winkle Co., Ltd. His topic was "Voltage and Current Fluctuations in the Output of Plating Rectifiers." The presentation included demonstrations performed with equipment furnished the branch by the following companies: Ther Electric Mfg. Company, Alfred Crossley & Associates and the Kocour Co.

Chicago has been having a board of experts, selected from its membership, answer questions during the first part of each meeting. December, however, had no such question period in order that the members and their guests could enjoy the free beer and pretzels which were furnished by the branch.

Announcements relative to the Chicago Annual Meeting were made. Chicago invites its many friends to attend the Banquet and Educational Session to be held January 29, 1955, at the Conrad Hilton Hotel. The speakers at the Chicago meeting will be:

Cleveland Nixon, General Motors,

Past President, A. E. S.; *Ezra Blount*, Editor, Products Finishing; *J. Coleman*, Victor Chemical Co.

Marion Longfield, is general chairman of the affair which is recognized as one of the outstanding A.E.S. Branch activities.

Jerome Kuderna,
Publicity Chairman

Cincinnati Branch

There were only twenty-two members and guests at the meeting of Cincinnati Branch on November 17, 1954 and the absent ones missed a good time and an interesting discussion on pressure blast finishing.

Pres. *Wm. Gordon* banged the gavel at 7:30 P.M., asking for reading of minutes of previous meeting. The application for admission of *Charles Kayser* was approved by the membership. *Dick Jager* of the Columbus Branch reported on further developments of the Second Annual Tri-State Dinner Dance to be held March 28 in Columbus, Ohio. Participation of the Dayton Branch is still in doubt, pending a polling of their members.

The speaker for the evening was *Alan Burman* of Cro-Plate Co., Inc. His talk on pressure-blast finishing was well delivered and very interesting. Mr. Burman emphasized the versatility of this method, pointing out the difference from conventional sand blasting. Essentially, this wet blast system utilizes a slurry of fine abrasive particles blown at high velocity against the item to be finished. Both a cleaning and a smoothing effect are achieved.

The system has many applications; such as cleaning and smoothing of difficult shapes, cleaning prior to plating, reduction of wheel work or buffing time, etc. The many questions asked were evidence of the interest aroused.

Merchants Chemical Co. was host at the usual social hour.

L. J. Howald,
Secretary

Central Michigan Branch

The November meeting of the Central Michigan Branch was held at the Meadow-Lark Inn, Jackson, on 11/9/54. An unusually delicious country style chicken dinner was served to the 40 members and guests through the courtesy of the meeting sponsor, Wagner Bros. Co.

Frank B. Lisowski of Wagner Bros. gave a very interesting talk on "Automation in the Plating Industry" and furnished a table of objectives for platers by which they can easily determine whether their operations warrant the installation of automatic equipment. He also presented a film concerning the installation and operation of one of their large automatic plating machines.

New members presented to the group at this time were *Francis E. Gazlay* and *Leslie Hanlon*.

R. W. Boos,
Publicity

INSTRUMENT SOCIETY OF AMERICA

Los Angeles has been selected as the host city for the 10th Annual Conference and Exhibit of the *Instrument Society of America*, President *William A. Wildhack* announced. Dates will be September 12-16, 1955 at the spacious Shrine Exposition Hall and Shrine Auditorium. Los Angeles was chosen because of the tremendous growth of industry and instrumentation in the area, according to Wildhack. The theme will be "Instrumentation Paces Automation."

Dr. Arnold O. Beckman has been appointed general chairman of the host committee, with *Fred Tabery*, 3443 S. Hill St., Los Angeles, set to serve as exhibit manager. Dr. Beckman, president of *Beckman Instruments, Inc.* will have *A. A. Anderson*, of Swissomatic Products, as his vice-chairman, and *Robert L. Galley*, of North American Aviation, as exhibit coordinator.

NATIONAL FEDERATION OF METAL FINISHERS

The *National Federation of Metal Finishers* has announced that its third

Management Seminar will be held on Saturday, January 29, 1955 at the Conrad Hilton Hotel, Chicago. The Seminar will be held in conjunction with the Annual Educational Sessions of the Chicago Branch, *American Electroplaters' Society*.

The program for the event will include talks on topics of interest to the management of job shops and finishing departments. These include sessions on Production Control for Metal Finishers by *Edward L. Barnett*, Binks Mfg. Co., Chicago; "The American Economic System," by *Charles M. Hanna*, The Everingham Co., Chicago; and "How to be a Profit Manager," by *Kenneth J. Eaton*, Associated Business Consultants, Chicago.

Federation President *J. Robert Greenwell*, Reliable Plating Corp., Chicago, has announced that the Seminar will again be sponsored by the Federation as a service to the industry, and that no charges are being made to those attending. Invitations to the event will be sent to owners and operators of job-shop finishing firms throughout the country, and to the managers of finishing departments of manufacturing firms. Attendance is limited to these groups.

On the evening preceding the Seminar—Friday, January 28th—a trip has been arranged by the *Chicago Electro-Platers Institute* for Seminar attendees to visit the electroless plating establishment of Kanigen Division, General American Transportation Corp., East Chicago, Ind.

A.S.T.M. Committee B-8 Electrodeposited Metallic Coatings Studies Corrosion Effects

The effects of various atmospheric environments on copper-nickel-chromium-plated steel panels as well as lead-plated steel panels was one of a number of subjects discussed by A.S.T.M. Committee B-8 on Electrodeposited Metallic Coatings at a recent meeting held in Philadelphia at A.S.T.M. Headquarters. A detailed report of the results will be published as a part of the 1955 report of Committee B-8. Six types of chromate coatings are being studied in four environments, two indoor and two outdoor. The indoor exposures are of two types, one in a box similar to that which would be used for shipping purposes and the other with specimens mounted on a rack. Outdoor exposures are at New York City and Kure Beach, N. C. The committee has decided to change its method of determining the weight loss of lead on lead-plated panels from the total weight loss of the panel to the individual weight loss on the separate sizes of the panels, that is, the upper and lower surfaces.

A committee section on tin and tin alloys has outlined a program of work which will consider first the effect of aging on solderability and will follow this with the development of a method of testing solderability. These early investigations will concern only essentially pure tin coatings. Later, they may include the tin-lead and tin-zinc coatings. A new section has been organized which will concern itself with measurements of stress in electrodeposited coatings, and a temporary task group has been set up to investigate the suitability of studying the effect of temperature on plated coatings. A task group is investigating the desirability of preparing specifications for the materials used in the plating industry. This would include such things as anodes, plating salts, etc.

A committee headed by *W. L. Pinner*, Houdaille-Hershey Corp., Detroit, Mich., has made tentative plans for holding a two session symposium during Committee Week at Buffalo in February 1956. The Symposium Committee will welcome suggestions for possible contributions of papers to be included in this symposium.

Because of the many studies in the field of metallic coatings, Committee B-8 will recommend to the A.S.T.M. Board of Directors at an early meeting that the scope of the committee be revised to include coatings applied by chemical reduction and plating materials used in the industry.

The next meeting of the committee is scheduled for January 1955.

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1—Belke plating unit complete with cylinder and tank. Melamine cylinder 14″ x 42″ with 5/32″ perforations, flexible ball contacts, complete with gears and hangars. Steel tank with coil, 56″ x 32″ x 32″ deep, with motor support, saddles, anode rods, bussed and insulated, but no motor or controls.

1—Lead lined steel tank, flanged, used as a chrome tank. Size 24″ x 72″ x 48″ deep.

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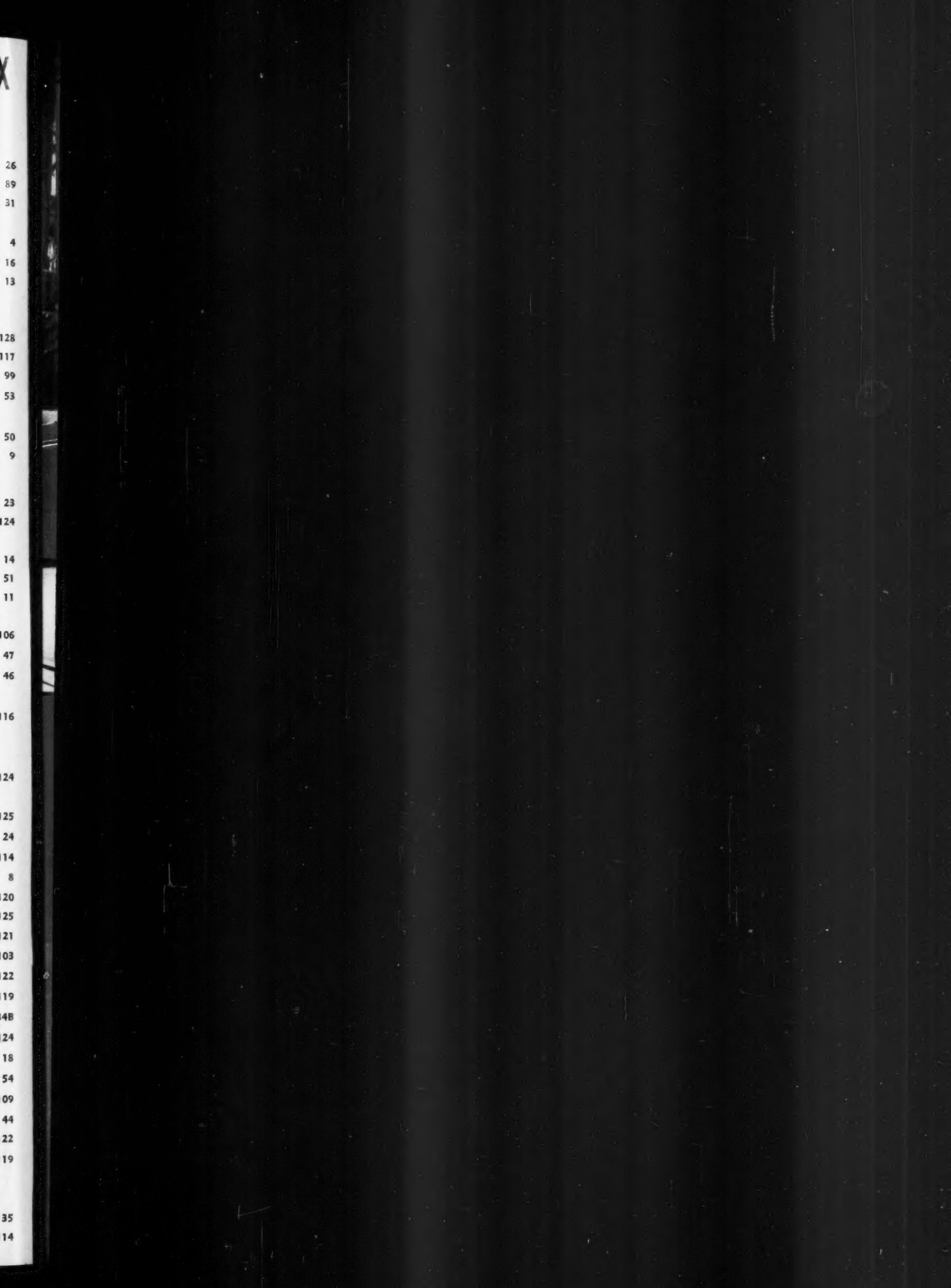
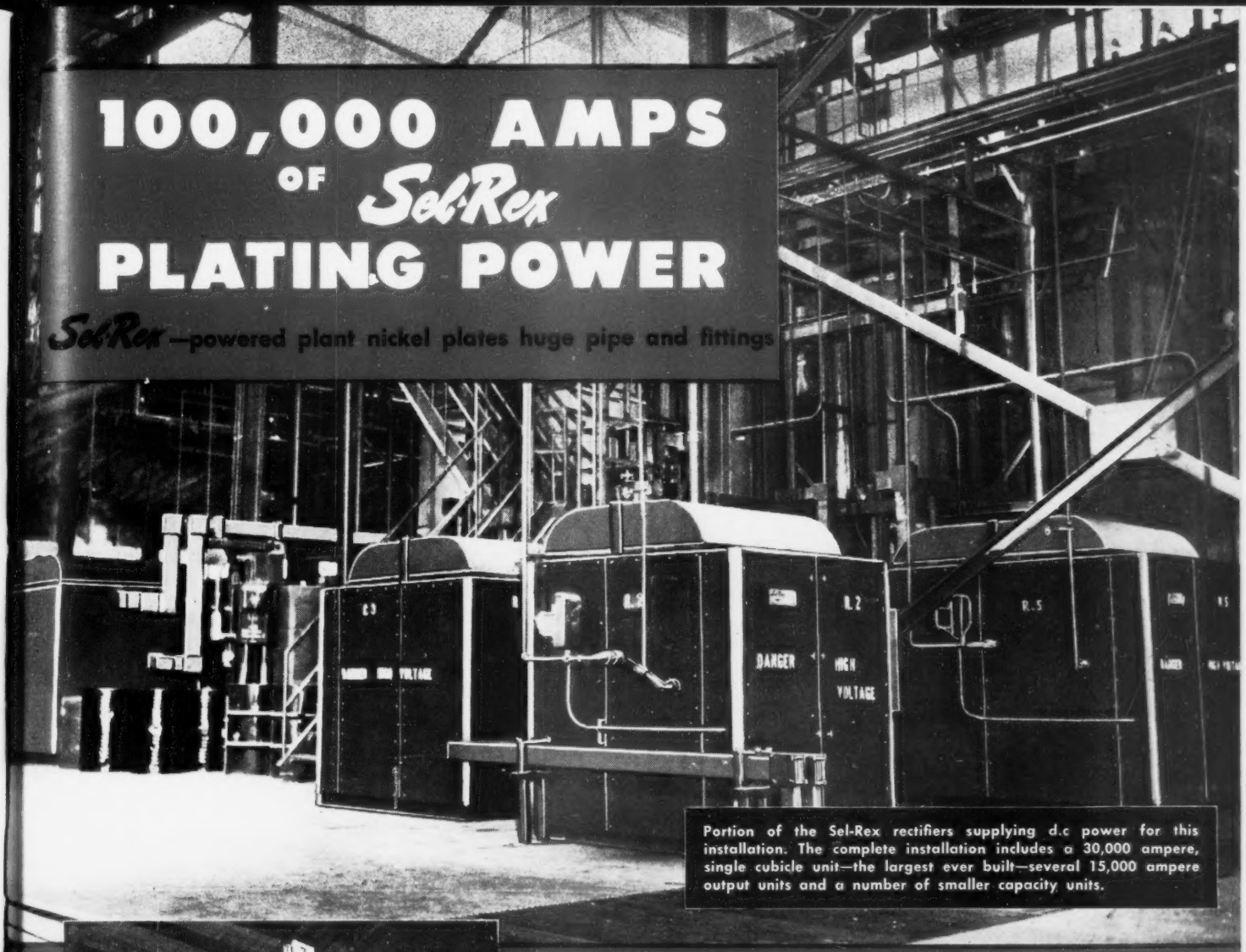
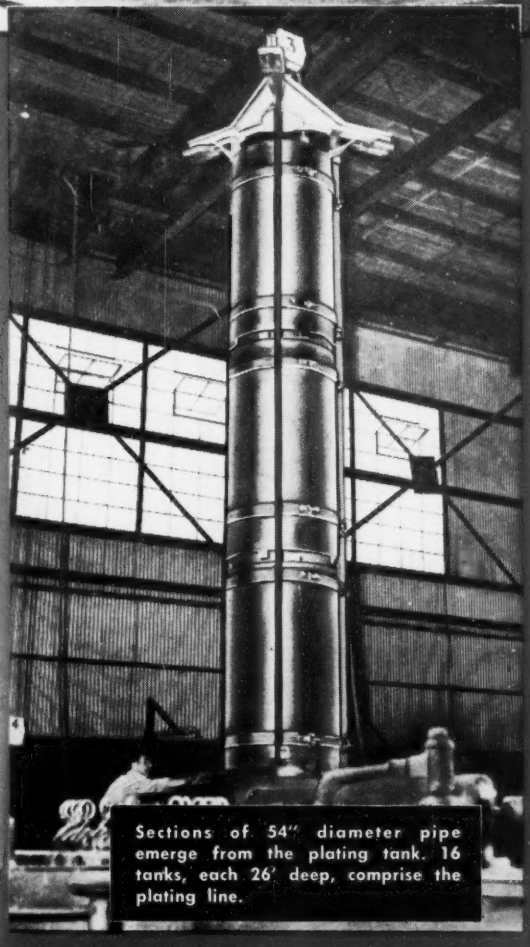


100,000 AMPS OF *Sel-Rex* PLATING POWER

***Sel-Rex*—powered plant nickel plates huge pipe and fittings**



Portion of the Sel-Rex rectifiers supplying d.c power for this installation. The complete installation includes a 30,000 ampere, single cubicle unit—the largest ever built—several 15,000 ampere output units and a number of smaller capacity units.



Sections of 54" diameter pipe emerge from the plating tank. 16 tanks, each 26' deep, comprise the plating line.

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